Industrial QUALITY CONTROL

VOL. IV JULY, 1947 NO. 1

CONVENTION ISSUE

George D. Edwards (on left), President of the American Society for Quality Control, presenting the Scroll enrolling Walter A. Shewhart, founder of Statistical Quality Control, as the first Honorary Member of the Society.

(See page 23)

AMERICAN SOCIETY FOR QUALITY CONTROL

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Statistical Quality Control Course The State University of Iowa Iowa City, Iowa, October 28-November 7

A ten-day intensive training course in **Quality Control by Statistical Methods** will be offered by The State University of Iowa at Iowa City, Iowa, October 28 to November 7 inclusive. This will be an introductory (not an advanced) course which will follow the same general pattern of previous introductory courses. The objective will be to acquaint industrial men with the general principles of Shewhart Control Charts and related topics, to present the basic concepts and operational procedures of modern scientific acceptance sampling, and to provide the training needed to make informed application of the techniques studied.

Instruction will be by lecture, demonstration, laboratory work, and evening question and problem discussion sessions, with the emphasis on practical interpretation throughout. The tuition fee of $100 per person includes such instructional materials as text, course outline, notebook, etc., but does not provide for any part of the living expenses. Room accommodations will be available at the Jefferson Hotel for those who wish to register there.

Further inquiries concerning this course should be addressed to: Professor Lloyd A. Knowler, Chairman, Department of Mathematics and Astronomy, The State University of Iowa, Iowa City, Iowa.

Apology

This issue of the magazine unquestionably sets some sort of record for delay in publication date! Let it be clearly understood, however, that this tardiness is not to be accepted as setting a precedent—publication on schedule is a primary objective which **must** and **will** be attained as speedily as possible!

The assignable causes responsible for the delay in this issue come from a "ganging up" of unforeseen circumstances which both the editorial office and the printer have done their best to overcome, obviously without too much success! We apologize for the failure, and are making every reasonable effort to bring future issues into closer harmony with scheduled publication dates.

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Correspondence is invited on all controversial matters.

General Information

INDUSTRIAL QUALITY CONTROL is published in January, March, May, July, September, and November, and is mailed to all members of the Society as one of the privileges of membership.

Direct Subscriptions to INDUSTRIAL QUALITY CONTROL will not be accepted from individuals. However, subscriptions to the magazine will be received from Libraries and like institutions at five dollars per year. Remittances must be in United States funds and should be sent directly to the Treasurer of the Society.

Membership in the American Society for Quality Control is available in three grades through local Sections or directly through the Executive Secretary. Annual dues for direct national membership are: for Members, $5.00; for Senior Members, $10.00; for Fellows, $15.00. The Member grade is open to any person of good character who is 21 years of age and engaged or interested in quality control. Information covering higher grades of membership and concerning local Sections may be obtained from the Executive Secretary.

Membership in the Society is personal and professional, and is not open to corporations, companies, or other organizations.

Contributions to the Society for the support of its activities will be accepted from corporations, companies, and others.

Advertising space in INDUSTRIAL QUALITY CONTROL is available, and arrangements for advertising may be made through the Treasurer.

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Cost of Back Issues

Most back issues can still be supplied individually at $1.00 each, but certain issues are now available only in complete volumes at $5.00 each. Volume I includes the six issues from July, 1944 through May, 1945. Volume II includes the six issues from July, 1945 through May, 1946. Volume III includes the six issues from July, 1946 through May, 1947.

A Practical Sequential Sampling Plan

A. A. GOODMAN

Steam Division Westinghouse Electric Corporation

Percentage inspection of incoming materials by Receiving Inspection Departments has long been the recognized method to control economically the incoming quality level. However, the simple act of ascertaining that a lot of material is either acceptable or not, should certainly not be construed to mean that full use has been made of the information uncovered by the inspectors. At the very least, Receiving Inspection should consist of a tight but rather flexible plan of inspection that effectively controls the incoming quality, and in addition uses the information gained to evaluate the vendor quality for future reference.

Unquestionably, it would be to our decided advantage to deal only with suppliers whose products run predominantly good. Careful and efficient pooling of records can greatly aid in weeding out the poorer supplier. Just one advantage of such information handling may be the following: Set-back production schedules due to rejected materials from outside suppliers are usually shrugged off as not being of our doings and therefore we should not be held accountable. In the event that such a circumstance is the result of an unfortunate lapse by a normally dependable supplier, then the excuse has merit. But should the difficulty be caused by a supplier whose merchandise in the past has not been on a par with that of other vendors and there are records to substantiate this claim, then the excuse has very little merit because action to forestall such a circumstance should have been instituted.

In plants where such statistics are available, it is not at all difficult in the normal course of supplier evaluation, to bring to the attention of the Purchasing Department those vendors whose quality level is unsatisfactory. Purchasing can then contact the suppliers with the intent of stating the case and prevailing upon them to overcome their manufacturing difficulties and thereby raise their quality to a satisfactory level. By thus evaluating the various suppliers, a Quality Control Department is able to render a service to its firm that is both constructive and worthwhile.

Here at the South Philadelphia Works, we use a simple, effective Sequential Sampling Plan to carry out our program. Previously we used a conventional Single Sampling Plan but the illustrated Sequential Plan has certain advantages. Although Sequential Sampling is in no way superior statistically to Single or Double Sampling, psychologically it is a better plan to use. First, the smaller average amount of inspection necessary is of importance and secondly, our own inspectors and suppliers both seem to like it, simply because they feel that it gives a lot of merchandise a reasonable chance of proving its merit. The mere fact that a larger number of smaller samples may be used carries with it the implication that we give a shipment of material more than

FIGURE 1

SEQUENTIAL SAMPLING PLAN
South Phila. Works

Lot Size	Sample Size	Combined	Sample	CRITICAL (A.C.L. .25%) Accept	CRITICAL (A.C.L. .25%) Reject	NON-CRITICAL (A.Q.L. 1%) Accept	NON-CRITICAL (A.Q.L. 1%) Reject
42	14	14	First	*	2	*	2
	14	28	Second	*	2	0	3
	14	42	Third	0	2	1	3
TO	14	56	Fourth	0	2	1	3
	14	70	Fifth	1	3	2	4
	14	84	Sixth	2	4	3	5
499	14	98	Seventh	3	4	4	5
500	20	20	First	*	2	*	2
	20	40	Second	*	2	0	3
	20	60	Third	*	2	1	3
TO	20	80	Fourth	0	2	2	4
	20	100	Fifth	0	2	2	4
	20	120	Sixth	0	2	2	4
999	20	140	Seventh	2	3	3	4
1000	30	30	First	*	2	*	3
	30	60	Second	*	2	0	3
	30	90	Third	0	2	1	4
TO	30	120	Fourth	0	2	2	4
	30	150	Fifth	1	3	3	6
	30	180	Sixth	1	3	5	7
1999	30	210	Seventh	2	3	6	7
2000	50	50	First	*	2	*	3
	50	100	Second	0	2	1	4
	50	150	Third	0	3	2	6
	50	200	Fourth	1	3	3	7
TO	50	250	Fifth	2	4	4	8
	50	300	Sixth	2	4	5	9
	50	350	Seventh	2	4	7	10
3999	50	400	Eighth	3	4	8	10
4000	75	75	First	*	2	0	4
	75	150	Second	0	3	2	5
	75	225	Third	0	3	3	7
OR	75	300	Fourth	1	4	5	9
	75	375	Fifth	2	5	7	10
	75	450	Sixth	2	5	9	11
OVER	75	525	Seventh	4	5	10	11

NOTE:
1. The samples must be random and be taken from the entire lot.
2. * means, do not accept until another sample is inspected.

P-35768-A

just one or two chances before rejection, even though to get the same protection less sampling will usually be necessary.

The illustrated plan, Figure 1, has two columns, headed "Critical" and "Non-Critical." The Critical Column has an Acceptable Quality Level of .25% which is very tight, and the Non-Critical Column has an Acceptable Quality Level of 1%, which in itself is still a good tight plan.

In use, the inspector uses the column applicable to the material being inspected. For example, in checking condenser tubes for wall thickness, we use the "critical" plan, as the highest quality level obtainable is necessary for this important function. On the other hand, ordinary nuts and bolts can be accepted on the more liberal "non-critical" plan.

Inasmuch as Class 7W studs with a Class 3 thread on the nut fit have two different criteria of acceptability, they are inspected by a combination plan; the stud end is checked by the "critical" plan and the Class 3 end by the "non-critical" plan. Using the combination plan of inspection, a shipment may be rejected if it fails on either of these plans, that is, it can only be accepted if it passes both inspection plans.

The second phase of the plan is to enter the shipments on a form, Figure 2, recording certain pertinent data, such as supplier, article, lot size, sample size necessary to accept or reject, disposition and remarks, if any. These data sheets are filled out by the inspector on the receiving end and sent to the staff supervisor in charge of the Statistical Control Division of Quality Control.

Using these data sheets as a basis, the information contained therein is compiled on a Supplier Evaluation Data Sheet, Figure 3, and filed for future reference. During the course of compiling these records, should the need for corrective action be indicated, then such action can usually be undertaken and the trouble found before the situation becomes acute or a crisis arises. In the final analysis, the fundamental value of Statistical Control lies in its ability to anticipate and prevent "hotspots" in all phases of the manufacturing

FIGURE 2

RECEIVING INSPECTION DATA SHEET

SUPPLIER Erie Bolt & Nut Co.
ARTICLE Studs 5/8" x 4 1/4"
LOT SIZE 277

SAMPLE	SAMPLE SIZE	NUMBER DEFECTIVE CRITICAL	NUMBER DEFECTIVE NON-CRITICAL	TYPE OF DEFECT	DISPOSITION
1	14	0	0		
2	14	0	0		
3	14	0	0		Accepted
4					
5					
6					
7					
8					

REMARKS:
T-60031
50/362995
Dwg 9-M-209

INSP. H.J. Hamilton
DATE 9/5/46

P-38769

FIGURE 3

SUPPLIER Pittsburgh Screw & Bolt Co
APPARATUS Studs & Bolts

DATE	ACCEPTED	TOTAL ACCEPTED	REJECTED	TOTAL REJECTED	SAMPLE SIZE	DEF.
7-30-46	2200	2200			100	0
7-31-46	1460	3660			90	0
8-12-46	1100	4760			90	0
8-13-46	5235	9995			150	0
8-27-46	550	10545			80	0
8-27-46	199	10744			42	0
8-27-46	660	11404			80	0
9-6-46	660	12064			80	0
9-6-46	275	12339			42	0
9-6-46	265	12604			42	0
9-6-46	275	12879			42	0
9-6-46	660	13539			80	0
9-19-46	1175	14714			90	0
9-19-46	2185	16899			100	0
10-18-46	225	17124			42	0
10-18-46	330	17454			70	1
10-18-46	1100	18554			90	0

cycle, a service for which it is uniquely adapted.

There is enough flexibility in this plan to enable it to be used rather universally. However, I believe that the "critical" and even the "non-critical" columns as used here, will prove a trifle too tight for some types of manufacture and I would recommend a 1% "critical" and 2% "non-critical" plan in that case. To establish such a plan, simply move the "non-critical" figures into the "critical" column and in the "non-critical" column insert the following figures, which are 2% A.Q.L.

	Accept	Reject
Lot size 42 to 499		
First	*	2
Second	0	3
Third	1	4
Fourth	3	5
Fifth	3	5
Sixth	3	5
Seventh	4	5
Lot size 500 to 999		
First	*	3
Second	0	4
Third	1	4
Fourth	2	5
Fifth	4	6
Sixth	4	6
Seventh	5	6
Lot size 1000 to 1999		
First	*	3
Second	1	4
Third	3	6
Fourth	5	7
Fifth	6	8
Sixth	7	9
Seventh	8	9
Lot size 2000 to 3999		
First	0	4
Second	2	6
Third	3	8
Fourth	5	10
Fifth	7	12
Sixth	9	14
Seventh	11	16
Eighth*	15	16
Lot size 4000 or over		
First	0	5
Second	3	8
Third	6	10
Fourth	8	13
Fifth	11	16
Sixth	13	18
Seventh	18	19

Process Control Methods

BERNARD HECHT

INTERNATIONAL RESISTANCE COMPANY

Before discussing the process control methods employed at our company, it may be well to mention that the name "International Resistance Company" denotes a company which manufactures all types of resistors used in electronic, industrial, and radio equipment. To those familiar with electrical theory, it is known that resistance is one of the three basic elements in any electrical circuit; the other two being capacitance and inductance. Our company specializes on resistance only, but makes every known form of resistor, and there are many forms. Our products are used in motor starters, radios, lighting circuits, electric mixers, heating pads, electric blankets, etc. There is hardly a single electrical or radio circuit that does not contain some form of resistor. The variety of forms of resistors, however, brings about a condition wherein we have separate departments that manufacture completely different items selling from less than one cent per unit to over fifty dollars per unit. The diversified nature of product does not alter the fact that certain basic methods of quality control are applicable; these methods will be the subject of this discussion.

The problem of quality control of processes has many phases. Among these phases are the following:

(a) Investigation, including design of experiments, measurement, and analysis;

(b) Quality reporting;

(c) Establishment of process control limits and acceptable quality levels;

(d) Periodic spot inspections at or immediately after processes requiring control;

(e) Recommendations for changes in processes or specifications;

(f) Establishment of lot-by-lot sampling plans in sub-assembly inspections;

(g) Posting of per cent defective charts to control important defects.

Taking each of the phases, the first one mentioned is investigation. Ordinarily the Quality Department's own records of per cent defective at various inspection positions serve as a first warning, but with increased quality mindedness on the part of supervisory personnel, many requests are made from other departments, notably by Department Foremen and Inspectors. Once the Quality Department decides to investigate, the problem is discussed and preliminary experiments are planned. The first steps are always to make some measurements and a preliminary analysis. To facilitate analysis, all Quality Department personnel have been trained to use the "Control Chart Method of Analysis of Data."*

As an example, see Figure 1,† which is a reproduction of a control chart data sheet designed for both analysis and process control. This data sheet is normally employed in almost all preliminary analyses since it gives the **central tendency** and **dispersion** of a group of observations in the simplest and most direct fashion. In the example shown, there is a simple comparison of the same machine at two different times which showed a significant variation with time on both central tendency and dispersion.

Often, making measurements must wait until a suitable measuring method is devised. It is worth a great deal to develop a method to enable a certain job of control to be accomplished, since the axiom **"You can't control what you**

*A.S.T.M. MANUAL ON PRESENTATION OF DATA. Published by American Society For Testing Materials.
AMERICAN WAR STANDARD Z1.1, GUIDE FOR QUALITY CONTROL. Published by American Standards Association.

†At the International Resistance Company we use the term "span" in place of the usual "range" to avoid confusion with another use of "range" meaning resistance value.

can't measure" has been proved many times in our operations. To cite an example, there is a certain characteristic which is termed "active length" in our smallest resistor, meaning the very short length through which the electric current will flow between the two terminals. In the special construction used in our product, this length depends upon the distance (approximately 0.2") between two lines of contact between a globule of conducting adhesive and the resistance element. Before the study, only an approximate comparison with a standard length on a go, no-go basis was employed; afterwards it was discovered that a shadow outline picture on an optical comparator screen could give a sufficiently precise and rapid picture to do the measurement. The optical comparator is now used right in the factory, and it is believed that its use, with accompanying control chart analysis, has led to improvement in uniformity and yield worth thousands of dollars per year.

If preliminary analysis shows a need for further experiments, then the Quality Department designs the further experiments and carries them out. After satisfactory analysis has been made, one or both of two possible decisions are reached, depending upon the results.

(a) If the process is capable of meeting the specification limits from the dispersion standpoint, but defectives are due to improper set-up (centering), then the responsible manufacturing department is requested to correct the condition.

(b) If the process is not capable of meeting the specification limits from the dispersion standpoint, even in small groups from one machine in good condition, then the matter is brought to the attention of the Process Engineering or Engineering Departments for improvement in machine or materials or process.

Although many types of analysis would be applicable to our problems, the nature of our product allows analysis by distribution or control chart method to do an excellent job. Our company sells resistors with resistance values within certain tolerance limits. (In statistical terms we could say at a certain average value and within a certain coefficient of variation.) For example, we may sell certain resistors at 100,000 ohms ±10% of that value, which means that the resistors we ship should be between 90,000 and 110,000 ohms. In our factory, due to the nature of the processes, the standard deviation we obtain may be a certain percentage of the nominal value, although our distributions are not exactly normal. In most cases, though, distributions approach normality so well that the percentage we find within the tolerance band is almost equal to the theoretical percentage found by dividing the standard deviation expressed as a percentage into the tolerance to obtain a value for t, and then checking standard tables for the corresponding area under the normal curve. This fact enables us to set our sights on the proper yields to expect in our production for the various tolerances.

For example, consider our ±10% tolerance resistors and assume a co-efficient of variation of 6%. Since our factory tolerance limits are ±9%, the t value at the tolerance limits is 9/6 or 1.5. Looking up the area under the normal curve between t = ±1.5, we find it to be approximately 86.6% of the total area. This means that if there is proper centering of the distribution curve at the nominal resistance value, then the yield within ±9% will be 86.6%. The yields with improper centering can also be calculated by obtaining the two unsymmetrical values of t and adding

FIGURE 1

WORK SHEET FOR CONTROL CHART

DEPT 39 — DATE 7/9/46

OPERATION OR PART NO END ASSEMBLY — ITEM MEASURED ACTIVE LENGTH IN THOUSANDTHS

OPERATOR MACHINE "4B" — INSPECTOR WARREN GOLD — SHIFT DAY

TIME, DATE OR GROUP		1	2	3	4	5	6	7	8	9	10	AVERAGES
READING 7/8/46	1	188	212	221	231	214	218	218	205	237	214	212
	2	227	239	232	217	208	234	225	240	220	222	227
	3	227	209	206	226	210	228	212	233	213	203	217
	4	210	240	214	211	212	235	207	213	220	204	221
	5	206	237	212	220	231	226	226	233	223	228	215
SUM		1058	1137	1085	1105	1075	1141	1088	1124	1113	1071	228
PLOT $\bar{x}$ = AVERAGE		212	227	217	221	215	228	218	225	223	214	218
MAX VALUE		227	240	232	231	231	235	226	240	237	228	225
MIN VALUE		188	209	206	211	208	219	207	205	213	203	223
PLOT R = SPAN		39	31	26	20	23	17	19	35	24	25	214
												$\bar{\bar{x}}_1$ 2200
												$\bar{x}_1$ 220.0
TIME, DATE OR GROUP		11	12	13	14	15	16	17	18	19	20	
READING 7/9/46	1	237	229	230	209	206	214	202	215	210	210	232
	2	234	233	225	218	180	197	204	200	218	221	220
	3	234	215	208	212	228	198	200	210	204	211	217
	4	230	218	203	209	212	196	205	208	214	206	208
	5	225	225	218	207	212	200	212	212	209	214	201
SUM		1160	1120	1084	1055	1038	1005	1023	1045	1055	1062	205
PLOT $\bar{x}$ = AVERAGE		232	224	217	211	208	201	205	209	211	212	209
MAX VALUE		237	233	230	218	228	214	212	215	218	221	211
MIN VALUE		225	215	203	207	180	196	200	200	204	206	212
PLOT R = SPAN		12	18	27	11	48	18	12	15	14	15	TOTAL 2130
												$\bar{\bar{x}}_2$ 213.0

REMARKS (ACTION TAKEN WHEN POINT IS OUT OF LIMITS) (PROCESS CHANGES, MATERIAL CHANGES, ETC.)

THESE DATA SHOW THAT MACHINE 4B CHANGED CHARACTERISTICS BOTH ON AVERAGE AND DISPERSION BETWEEN 7/8/46 AND 7/9/46. INVESTIGATION SHOWS THAT ON 7/9 A NEW CONTACT PAINT WAS USED. IT IS PROBABLE CAUSE OF THE CHANGE FOR THE BETTER.

												39
												31
												26
												20
												23
												17
												19
												35
												24
												25
												259
												$\bar{R}$ 25.9
												12
												18
												27
												11
												48
												18
												12
												15
												14
												15
												TOTAL 190
												$\bar{R}_2$ 19.0

CONTROL LIMIT CALCULATIONS

CONTROL LIMITS

AVERAGES
HIGH
LOW
SPANS
HIGH
LOW

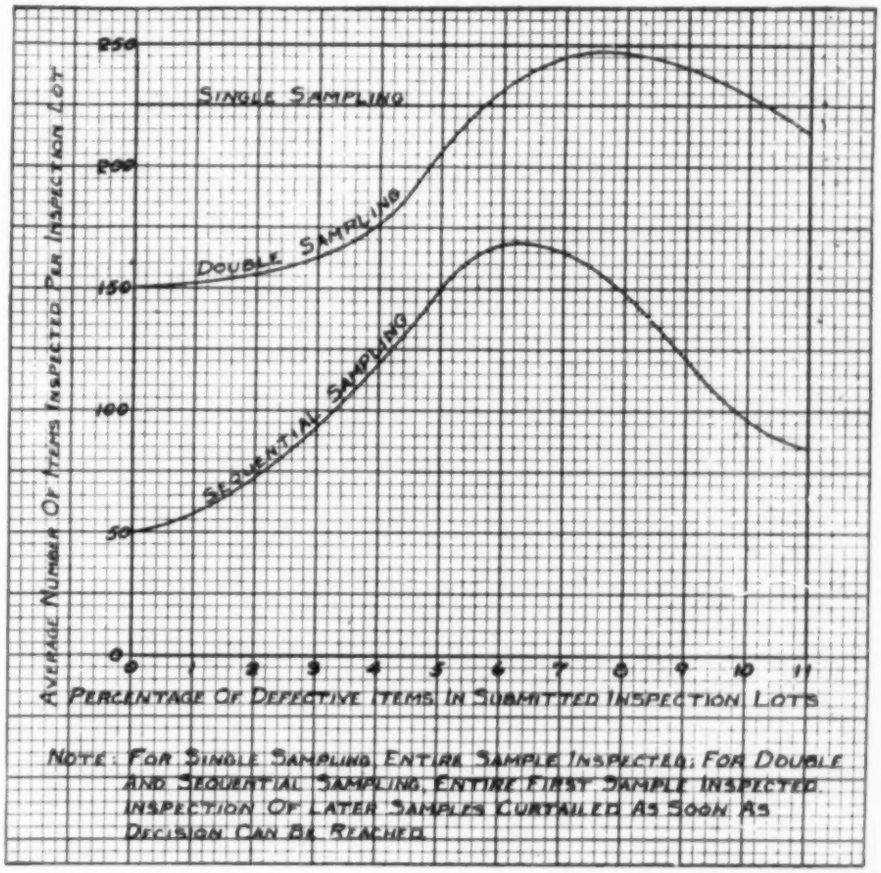
the corresponding areas under the normal curve.

The handling of changes in specifications is a definite part of process control, and its importance cannot be overestimated. Without proper specifications, the manufacturing personnel will either perform a certain operation so carefully to meet an exceptionally strict specification that they ignore some other important elements of the process, or, on the other hand, they may completely ignore the specification because they know they can't meet it. Both of these practices are extremely dangerous and wasteful. It is wise for the Quality Department to spend a great deal of time in working with the engineers on these problems. Since the Quality Department has the responsibility for the final quality of the product, that department is in a good position to determine when relaxation in a given process is practicable.

After the establishment of the necessary limits, the Quality Department, with the cooperation of the department foreman concerned, establishes the necessary spot inspections to control the quality at the pre-determined level. It has been found, as many other quality control operators have noted, that the installation of a proper in-process inspection always results in **better quality**; it does not merely hold the quality at a given level.

In our company we use two different methods for in-process inspection. The first is the normal in-process method of frequent small samples of fixed size with immediate corrective action to be required by the checker. The other method is the use of standard Dodge and Romig single and double sampling plans as lot-by-lot process controls at sub-assembly inspection points. We have had much success with both methods, and especially when the two methods are used in tandem. In other words, a spot check is taken directly after a process, using small samples and taking immediate corrective action as required, and then at the subsequent sub-assembly inspection or test point a standard Dodge and Romig lot-by-lot sampling table is employed. In every case the combination of these two methods has enabled us to change from 100% inspection to a relatively strict

Figure 2—AVERAGE AMOUNT OF INSPECTION WITH DIFFERENT SAMPLING PLANS


250
200
150
100
50
0
0 1 2 3 4 5 6 7 8 9 10 11
Single Sampling
Double Sampling
Sequential Sampling
Average Number Of Items Inspected Per Inspection Lot
Percentage Of Defective Items In Submitted Inspection Lots
Note: For Single Sampling, Entire Sample Inspected; For Double And Sequential Sampling, Entire First Sample Inspected. Inspection Of Later Samples Curtailed As Soon As Decision Can Be Reached.

sampling plan; and then, within three months, we have been able to go to a very much reduced sampling plan.

The method of establishment of sub-assembly inspection sampling plans may be of interest to practical men in the field. Our routine is as follows. A study is made of the inspection standards at a given inspection operation; they are reset if necessary after performance tests and checks at subsequent operations give the facts needed. Data are then collected on the apparent process average of the product reaching the inspection point, using the 100% inspection results. A check is made as to whether there are many borderline sub-lots or whether the sub-lots vary from very good to very bad in most cases with very few in between. After this study, reinspection is performed, using Quality Department personnel, to determine the efficiency of the present 100% inspection and also to determine the actual Average Outgoing Quality, AOQ. If this AOQ is satisfactory for later processes we need go no further, and at our plant this is usually found to be the case. After determination of the apparent process average and AOQ, we then approximate the true process average by adding the AOQ to the apparent process average, all expressed as per cent defectives.

After the foregoing information has been obtained, determination of the sampling plan is made as follows: First, we decide whether the sampling should be single, double, or sequential. To do this in a very simple fashion, the data on the distribution of defectives in sub-lots are considered. If we find the quality substantially constant from sub-lot to sub-lot, single sampling is used; if we find the sub-lots go from very good to very bad with very few in between, we choose double or sequential sampling. The reasoning behind these selections can be seen by examination of Fig-

ure 2* which compares graphically the variation in the average amount of inspection, as lot fraction defective varies, for a single, double, and sequential sampling plan each of which has essentially the same operating characteristic curve.

At the present time, however, sequential sampling is not being employed in any in-process inspection other than Receiving Inspection. The added grouping, counting, and record keeping on sequential sampling are objectionable to inspection personnel. We are working on the development of a sequential sampling machine in an attempt to avoid the necessity of grouping and counting. If this is successful, we expect to try sequential sampling in some suitable spots.

After determination of the type of sampling, we use the Dodge and Romig **Sampling Inspection Tables**, choosing the AOQL equal to the AOQ found in 100% inspection, and the process average obtained by adding the apparent process average to the AOQ. If the process average is poorer than the worst allowed on the Dodge and Romig Table for the AOQL required, steps are taken to improve the process, and the minimum risk table is chosen and put into operation.

Having made the choice of the sampling plan and the specific table, the plan is put into operation, and, after a week, the per cent of the lots passed on sampling and the actual process average found are noted. Using these figures, we can easily tell whether the sampling is successful, and thereafter from time to time the figures are rechecked and new reduced or stricter tables established depending on these results. New tables are established issuing sampling layouts somewhat as used at the Western Electric Company,†. It may be of interest to note that in every case we have gone to reduced sampling rather than to stricter sampling in terms of size or samples required. In actual practice we shift to lower AOQL's as time goes on, but the process averages always continue to improve at such a rate that reduced sampling is obtained in spite of stricter AOQL requirements.

To cite an example, in the winding department for our wire wound resistors, we were able to obtain better quality at the sub-assembly inspection and test points by means of spot-checking resistors from each winder at frequent intervals. As a result, the inspection and test operations which had required four inspectors are now being handled by one inspector with the same production volume. During a peak production period we were able to handle three times the volume of production with only two inspectors. In addition to saving inspection costs, the quality level expressed as a per cent defective was reduced from 6% to 2% within three months, and has been held at or near that level ever since.

Of course, in addition to the different types of per cent defective controls, average and range control chart methods are used at certain spots, especially in our punch press shop, on our screw machines, and even in the middle of a production belt fabricating radio volume controls.

This last is an interesting application of the control chart since it is a perfect example of a place where a control chart can do a good job. The measurement required is the contact pressure of a finger on a resistance element. The method used before the control chart was installed was feeling for the pressure by an operator who adjusted the finger without making any measurements other than a sense of touch (the pressure was approximately 5 ounces).

This operator is in the middle of a production belt, and no checks other than periodic spot checks by Engineering personnel were ever made. Because of the fact that there was a sub-assembly inspector on the production belt who checked the contact finger assembly for other things, the Quality Department gave that girl a spring scale and had data maintained on five units per hour for a few days with the finger adjuster on the belt also. Once this combination was set up, the operator taking the measurements started to inform the supervisor of each case where the fingers showed themselves to be outside the regular specification limits. The supervisor would then tell the finger adjuster to make the necessary changes in her technique to bring the pressure within limits.

After a week, we had this subassembly inspector start a control chart without setting limits. The data were then analyzed and control limits set in accordance with standard procedures.* Once this control chart was put into operation, it was found that the finger adjuster was not always necessary since some types of contact fingers were much better controlled with regard to pressure when no adjustments were made. This allowed us to remove the adjustment operation on one production line while keeping it on another production line making a similar item. Weeks of experience showed that the line where there was no adjustment did a better job than the other, and the finger adjustment has been removed from both lines except at such times as the control charts show points out of control. Even in these out of control cases, however, it was found that it is not a matter of finger adjustment but poor assembly technique at a prior point on the production line, such as poor soldering, or improper fit of parts.* We now run for weeks at a time without a single point outside of control limits, and since these control limits are well within the Engineering specification limits, we do not have any trouble with this characteristic.

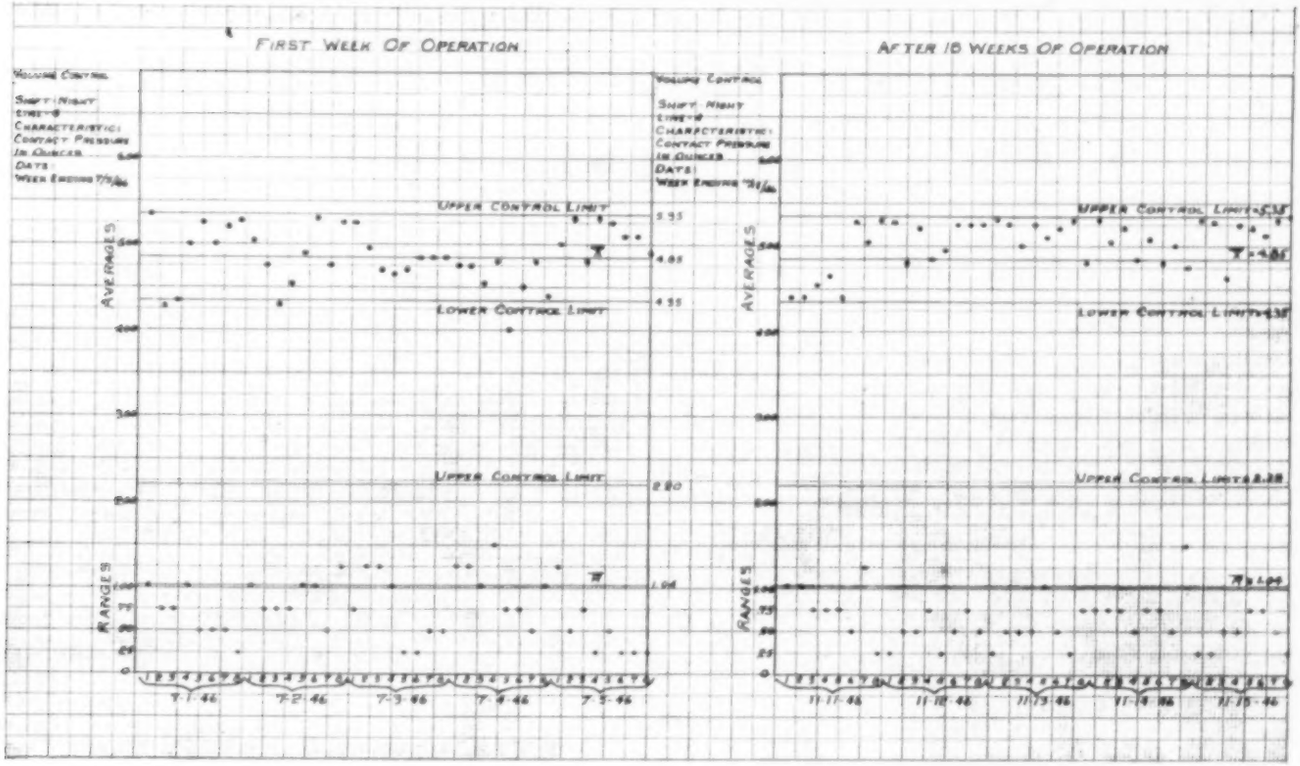
Control of this contact pressure, in turn, gives us more uniformity in rotational life characteristics and noise characteristics, both of which are very important in volume controls for radio use. Figure 3 shows the chart for a typical week at the start and after 18 weeks of use on a production line.

*This graph is based on work done by the Statistical Research Group at Columbia and Princeton Universities on Navy Project N-120 during World War II. The specific information involved appeared on Page 25 of the AMP Memo 176.1, dated June, 1945, entitled "Sampling Inspection."

†Keeling, D.B. and Cisne, L.E. BELL SYSTEM TECHNICAL JOURNAL, Vol. XXI, pp. 37-50, June, 1942. (Also reprinted in Dodge and Romig book referred to above.)

*AMERICAN WAR STANDARDS Z1.3 - 1942, American Standards Association.

Figure 3—EFFECT OF CONTROL CHART ON VOLUME CONTROL OF CONTACT PRESSURE.



Besides the above methods, one other well known technique is used, namely, the daily per cent defective chart, especially when it is known that the per cent defective level is higher than the process should have. For example, on one product, poor appearance of coating (for which the primary cause was poor handling) during peak production periods fluctuated about a level of approximately 6%. It was noted that the reason for this was that supervisory personnel did not know exactly how they had run the day before, and therefore did not take corrective action soon enough. In this connection, it should be mentioned that at our company the Quality Control Department issues weekly inspection and test reports, but it is obvious that a report which is issued on Tuesday of the week following a production week cannot do much good for the previous production week. A daily per cent defective chart was put into operation for this defect (which we knew the supervisors could control), and after two months of operation the per cent defective went to 3%. This is a 50% reduction in per cent defective. At the present writing, this has improved to less than 2% defective.

As hints to people considering the employment of the daily per cent defective charts, our experience shows that such a chart should be large, and should be placed in a conspicuous spot as near to the operations causing the defect as possible. We also found that the points on the chart should be plotted no later than one hour after production begins on the morning following the day of inspection, and that a danger line, calculated as a 3-sigma limit, should be included. Unless these rules are followed, the proper results may not be forthcoming.

The International Resistance Company has found that the introduction of statistical process control by means of the methods just described has paid dividends in lower unit cost and higher quality in all cases. Lack of space prevents description in detail of our most interesting process which is the manufacture of composition resistors. We produce these resistors at a rate of over 20,000,000 a month, so handling quality control on this item is quite an interesting problem, especially since we do not manufacture exactly the same item 20,000,000 times, but rather in various groups, including different sizes and resistance values, all of which have their special problems.

The MID-WEST QUALITY CONTROL CONFERENCE and the AMERICAN SOCIETY for QUALITY CONTROL take pleasure in announcing availability of 500 more copies of CONFERENCE PAPERS. (See page 18).

Life Test Predictions by Statistical Methods To Expedite Radio Tube Shipments

J. ALFRED DAVIES

GENERAL ELECTRIC CO.

Summary

To eliminate a 3½ weeks' holding time until completed life tests indicate proper disposition of production, a quality control method was devised to release production lots of radio tubes for shipment in a few days. All production lots of tubes whose life test samples of 10 tubes each meet the criteria established by this method are released for shipment usually within four days, while their respective life tests are continued to 500 hours. Of the hundreds of shipments released by this method, none had shown a failure of its life test sample with respect to the 80% requirement after the shipment was made.

Previous life test records are used to assign a Rating Number to each tube type. Concurrent life test data are employed to determine whether or not the rating of the sample exceeds the minimum acceptance percentage required for production release. Standardization of six Rating Plan Numbers and their corresponding Acceptance Figures permitted the use of graphical aids to minimize clerical work.

When the quality of the tubes is satisfactory, approximately 90% of all production may be released by this method within 4 days after manufacture instead of being held 24 days until life test completion. Since, in the case where this method was applied, only about 3% of the production had to be held the full 500 hours, the time-saving feature of this release method is apparent for high quality product, particularly on rush shipments.

In order to facilitate shipments of radio tubes prior to completion of the 500-hours' life test run on a sample from each production lot, some method was required to approximate the final rating of the sample. According to specifications, any production lot is acceptable if its final rating is not less than 80%. Consequently, it was sufficient to establish a predicting system which will forecast not the exact final rating, but whether or not that rating will be 80% or better at 500 hours.

Accelerated life tests have not proved reliable, although they undoubtedly save time and life test shelf space. Life test results obtained from elevated heater voltages and/or increased plate (or screen) voltages showed only fair correlation with results of regular tests. Hence, accelerated life tests, physically speaking, were not the answer.

Investigation of this problem with the aid of certain statistical techniques and empirical choices led to the development of a Life Test Rating Acceptance Method based on:

1. Previous Life Test Data of the tube type under test; and
2. Life Test Ratings of the sample at specified reading periods during that test.

The Life Test Ratings for groups of ten samples of ten tubes each provided the statistics $\bar{r}$, the average rating, and R, a form of range. From these figures, the distribution of tube life-expectancy was estimated. Further, the moving average and range of the last ten ratings indicated the trend of tube life-expectancy as affected by production and material changes.

In terms of (1) above, a form, "Computation of Minimum Life Test Ratings for Lot Acceptance," Fig. 1, was devised to provide an up-to-date record of the moving average rating and the range for the last ten samples of ten tubes each for each tube type. Then Chart 1, "Selection of Minimum Life Test Rating Acceptance Plans," Fig. 2, proved a quick means for a rating (or re-rating) of each type on the basis of the current $\bar{r}$, R combination.

In accordance with (2) above, Table 1, "Minimum Life Test Ratings for Acceptance of Lot at Reading Period Indicated," was established to hold the more uncertain samples longer until data at later reading periods indicated a high probability of acceptable ratings at 500 hours.

Operation of Release System

Each tube type is periodically assigned a Rating Plan Number from 1 to 6 on the basis of its ten previous life test ratings determined from samples. Rating Plan No. 1 is associated with the best quality, taking into consideration both the level and spread, and represents the most reliable results of life tests. If a tube type is assigned Rating Plan No. 1, the next production lot of this type is released for shipment after the 16 hours' life test reading period, provided the rating of its life test sample is 100% at this reading period. Otherwise, this lot will be held until the rating of its sample at a later reading period is not less than the minimum rating required for release at the period indicated for Plan No. 1.

Rating Plan No. 6 represents the most uncertain life test results, and tubes assigned to this grouping or Rating Plan Number may not be shipped until completion of the 500 hours' life test. The intermediate Rating Plans No. 2, 3, 4, and 5 indicate a decreasing reliability in life test results and, consequently, the earliest reading periods at which tube types in these groupings may be released are 42, 84, 126, or 275 hours, respectively, with a sample rating of 100%.

FIGURE 1

COMPUTATION OF MINIMUM LIFE TEST RATINGS FOR LOT ACCEPTANCE

LOT NO.	PRODUCT. DATE	500 HR. RATING	10TH LAST RATING	RATING DIFFERENCE	CURRENT 10-LOT AVERAGE*	RANGE	RATING PLAN NUMBER	DATE OF COMPUTATION
1	1-7-46	100	Enter in this column the Rating of the Lot whose number is (N-10), where N is the number of the most recent life test lot being "averaged in"	Subtract "10th Last Rating" from rating of Nth lot and record. (+ if Nth rating is the larger, and — if smaller).	$\bar{r}$	R		
2	1-14-46	86						
3	1-21-46	100			95.3	25	3	2-22-46
4	1-28-46	100			96.5	22.5	2	2-28-46
5	2-4-46	92			95.6	20	2	3-7-46
6	2-11-46	91			94.8	18	2	3-15-46
7	2-18-46	100			95.6	17	2	3-20-46
8	2-25-46	90			94.9	16	2	3-28-46
9	3-4-46	82			93.4	18	3	4-5-46
10	3-11-46	85			92.6	18	3	4-11-46
11	3-18-46	90	1 100	-10	91.6	18	3	4-19-46
12	3-25-46	88	2 86	+2	91.8	18	3	4-25-46
13	4-1-46	74	3 100	-26	89.2	26	5	5-3-46
14	4-8-46	97	4 100	-3	88.9	26	5	5-10-46
15	4-15-46	100	5 92	+8	89.7	26	5	5-16-46
16	4-22-46	100	6 91	+9	90.6	26	4	5-24-46
17			7					

*Current 10-Lot Average = (0.1) (Rating Difference) + (Preceding 10-Lot Average)
(For average rating on less than 10 lots, see page 14, bottom of first column)

See Table 1 for these required ratings at the specified Reading Periods. For 500 hours these ratings must be 80% or more for acceptance.

It is evident that there are three distinct phases of the release procedure as follows:

1. Computation of the Average Life Test Rating, $\bar{r}$, and the range R, for the ten preceding samples of ten tubes each (special rule described below applies when number of preceding samples is less than ten);
2. Selection of the Rating Plan Number corresponding to $\bar{r}$, R; and
3. Application of the acceptance criteria expressed in percentages for the selected Rating Plan to determine whether it is advisable to permit early release of production.

The graphical aids previously mentioned apply to these three phases respectively in the following sequence:

1. Fig. 1: Form S-2255, Computation of Minimum Life Test Ratings for Lot Acceptance;
2. Fig. 2: Chart No. 1, Selection of Minimum Life Test Rating Plans; and
3. Table 1: Minimum Life Test Ratings for Acceptance of Lot at Reading Period Indicated.

These forms are reproduced here, together with an illustration of their use. The data are entirely hypothetical and are representative of the method only, not any tube type. Computations of $\bar{r}$ and R on the form are self-explanatory, and the points represented by $\bar{r}$, R have been plotted on Chart No. 1. These points show how the life test rating trend influences the selection of the appropriate rating plan. Notice that the failing rating, 74%, of lot No. 13 not only lowers $\bar{r}$ to 89.2% (which would drop the point into Plan No. 4 at the 18% R level), but also increases R to 26% which results in the selection of Plan No. 5. Further, as long as this 74% rating remains in the ten last ratings, it exerts considerable influence on the selection. A definite upward trend of ratings is required to raise $\bar{r}$ enough to warrant a change to Plan No. 4 as shown by the last three ratings.

Finally, Table 1 shows that for Plan No. 3, no lot may be shipped prior to 84 hours. Let us suppose that the ratings of the failing lot were as follows: 0 hours, 100%; 16 hours, 100%; 42 hours, 100%; 84 hours, 92%; 126 hours, 89%; 275 hours, 85%; and 500 hours, 74% — a typical case of rapid decline of rating from about 100

TABLE 1 MINIMUM LIFE TEST RATINGS FOR ACCEPTANCE OF LOT AT READING PERIOD INDICATED

Rating Plan No.	Ratings Required at Hours 0	16	42	84	126	275	500
1	*	100	94	90	88	82	80
2	*	*	100	94	91	85	80
3	*	*	*	100	95	87	80
4	*	*	*	*	100	91	80
5	*	*	*	*	*	100	80
6	*	*	*	*	*	*	80

*No production lot accepted at this hour at any rating.

hours. Plan No. 3 does not permit shipment of this lot with these ratings at 84, 126, or 275 hours. Consequently, it will be held until 500 hours, and the failure will be caught. However, if the ratings of this failing lot were such that it was released for shipment prior to 500 hours, and the failure was not apparent until the final rating, two courses of action start.

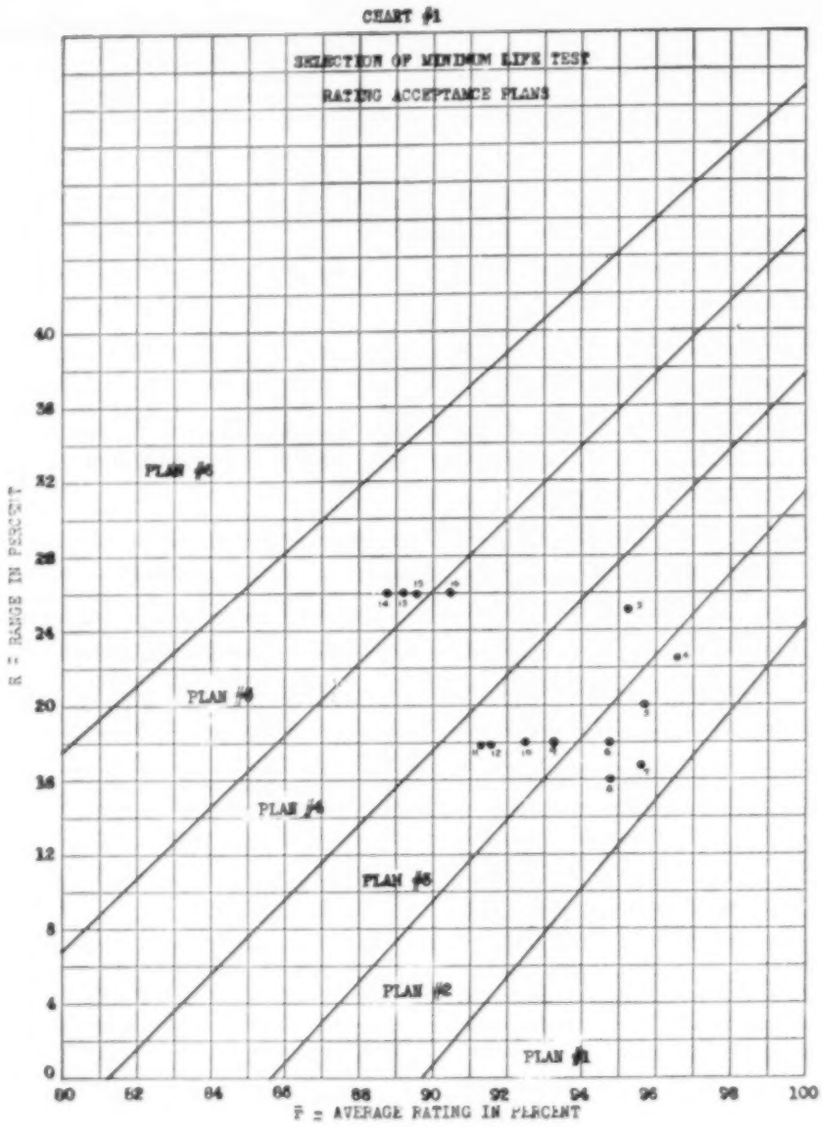
1. Another sample of twenty tubes (already available) from the same production is life-tested, and its rating is combined with the original ones as a total sampling check for sampling fluctuations of real operating trouble.
2. The rating of the original failing sample only is recorded, and it immediately increases the holding time for several subsequent lots by dropping the Rating Plan Number. This action serves as a precaution against a possible downward trend of quality.

Life test ratings for all tube types are kept up-to-date by the Quality Control Laboratory, and monthly reports are forwarded to the Shipping Section. The Shipping Section is immediately advised of any interim changes in ratings. Thus it is a simple matter for the Shipping Section to check the life test status of any particular tube type in order to determine whether or not shipment of said type may be made.

Inasmuch as all calculations are based on ten ratings, the question will undoubtedly arise concerning the selection of rating plans in the case of new production which has no previous life test records, or less than ten. This case is covered by the following rules for computation of $\bar{r}$ and R.

1. The average rating, $\bar{r}$, shall be the arithmetical average of the ratings represented, which in no case may be less than three in number; and
2. The range, R, of the ratings shall be determined from the equation $R = K(100 - r_{min})$, where r_{min} is the smallest rating used, and K is a factor which varies with the number of ratings used. The factor K is approximately the square root of (10/(number of ratings used)) and allows for greater sampling variation inherent in the small number of ratings. Obviously $K = 1$ for the usual ten ratings.

FIGURE 2



Theoretical Basis of Method

The rating of any life test sample involves several factors. Tube inoperation may occur either gradually or abruptly. The gradual decline type is illustrated by the "die away" curves of transconductance, power output, AC amplification, and emission. The abrupt, inoperative type is illustrated by the "sudden death" failures resulting from burnouts, shorts, arc-overs, and open elements. The rating can be made a function of the controllable factors:

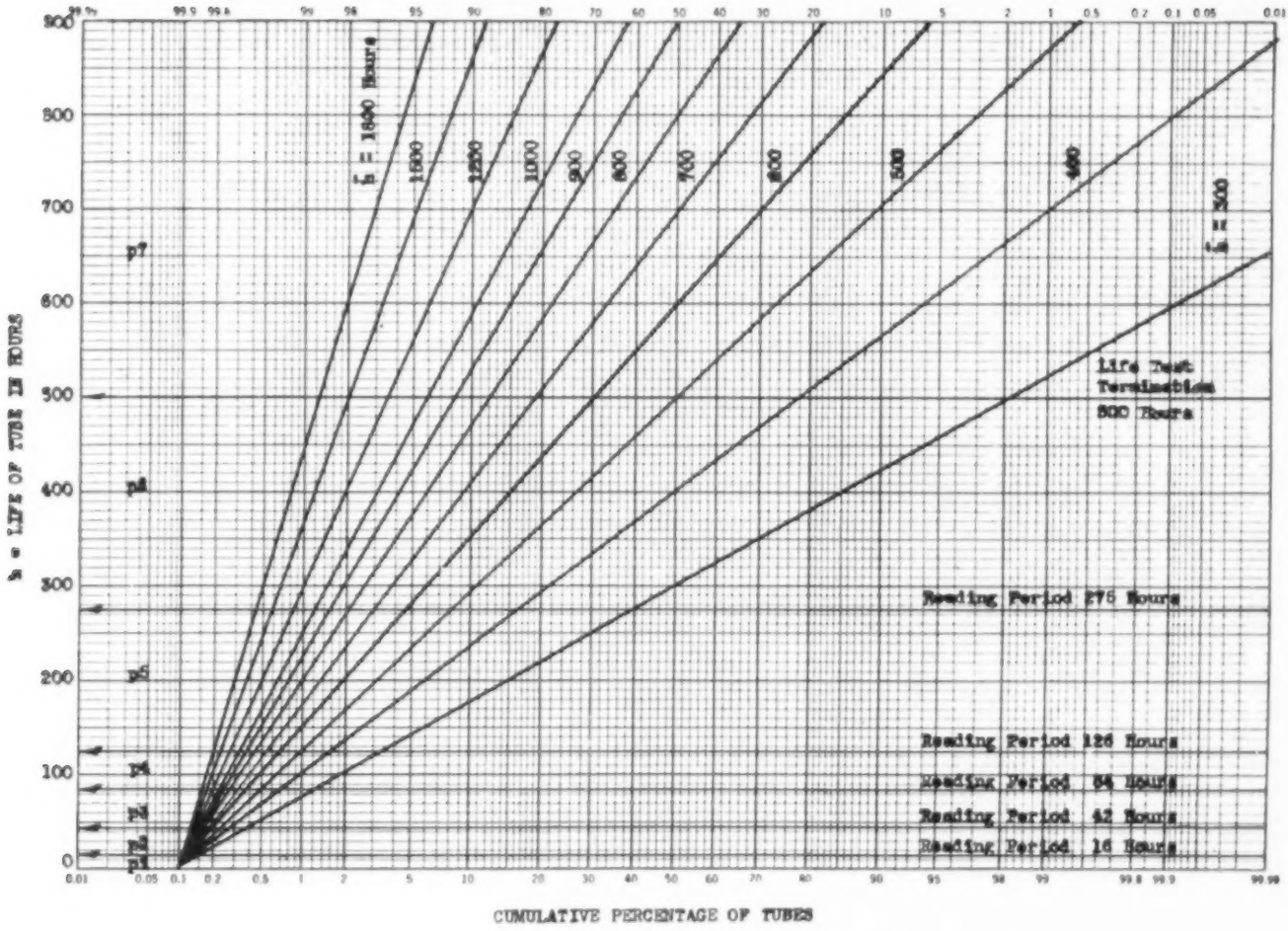
1. Total Operating Time,
2. Number of Tubes in the Sample,
3. Group of Tube Characteristics, and
4. End Point Tolerance.

The first two factors are used directly in the life test rating formula, and the latter two factors are covered by specification. In the method presented herein factors 1, 2, and 4 are:

1. 500 hours,
2. n = 10, and
4. 80%.

This rating is simply an expression of the percentage of total specified operating time during which the tubes remain operative.

Figure 3—THEORETICAL DISTRIBUTION OF TUBE LIFE



The life test rating equation is:

(1) $r = (nt - \Sigma x_i)/nt$

where r = life test rating (expressed in per cent usually),
t = time in hours specified for life test duration,
n = number of tubes in life test sample, and
x_i = unexpired remainder of t in hours at failure of the ith tube.

This equation is easily changed into a form more suited to statistical calculation. Let h_i = operative life in hours of ith tube until the time of failure. Then,

(2) $x_i = t - h_i$, and the summation for n tubes gives

(3) $\Sigma x_i = \Sigma(t - h_i) = nt - \Sigma h_i$.

Substitution of (3) in equation (1) gives

(4) $r = [nt - (nt - \Sigma h_i)]/nt = \Sigma h_i/nt$.

The probability of a tube failure between successive reading periods is readily found from the theoretical ogive of tube life . Fig. 3 presents the ogives used in developing the method described herein. The assumed theoretical distributions are plotted on probability paper as straight lines with 0 hours assumed at 0.1% for all valuations of $\bar{h}$, the average tube life, and with each $\bar{h}$ distribution passing through the point $h = \bar{h}$ and $p = 50\%$. Curves for average life figures from $\bar{h} =$ 300 to 1800 hours are given. The specified reading periods are indicated at hours 0, 16, 42, 84, 126, 275, and 500. The cumulative percentage of expected tube failures (for each curve) at these reading periods are easily determined from the intersection of the ogive and the reading period lines. Then the percentages between successive reading periods are obtained by subtraction. By using these probabilities, p_i, weighted by the respective midpoints, t_i, of each time interval between readings, the total expected life is obtained from

(5) $\Sigma h_i = \Sigma t_i p_i$.

Taking $t = 500$ hours as specified and $n = 1$ for any tube, the desired formula is obtained in statistical form as

(6) $\bar{r} = .002 \Sigma t_i p_i$.

For the case of average tube life of 600 hours the average rating is $\bar{r}(600) = 91.7\%$ where $t_i = 500$ is used with $p_i = .697$ for the reading period over 500, and the

remaining t_i and p_i values are respectively: t_i, p_i — 400, .253; 200, .042; 100, .004; 60, .002; 30, .0005; and 10, .0005. The t_i values are approximate midpoint values for the reading period values used, e.g. 400 corresponds to the interval between 275 and 500, likewise the probability values are the differences between the reading period values.

Using the same procedure, similar calculations for the other average life periods provide data for plotting the curve of $\bar{r}$ versus $\bar{h}$ shown in Fig. 4, "Life Test Ratings at 500 Hours vs. Average Tube Life."

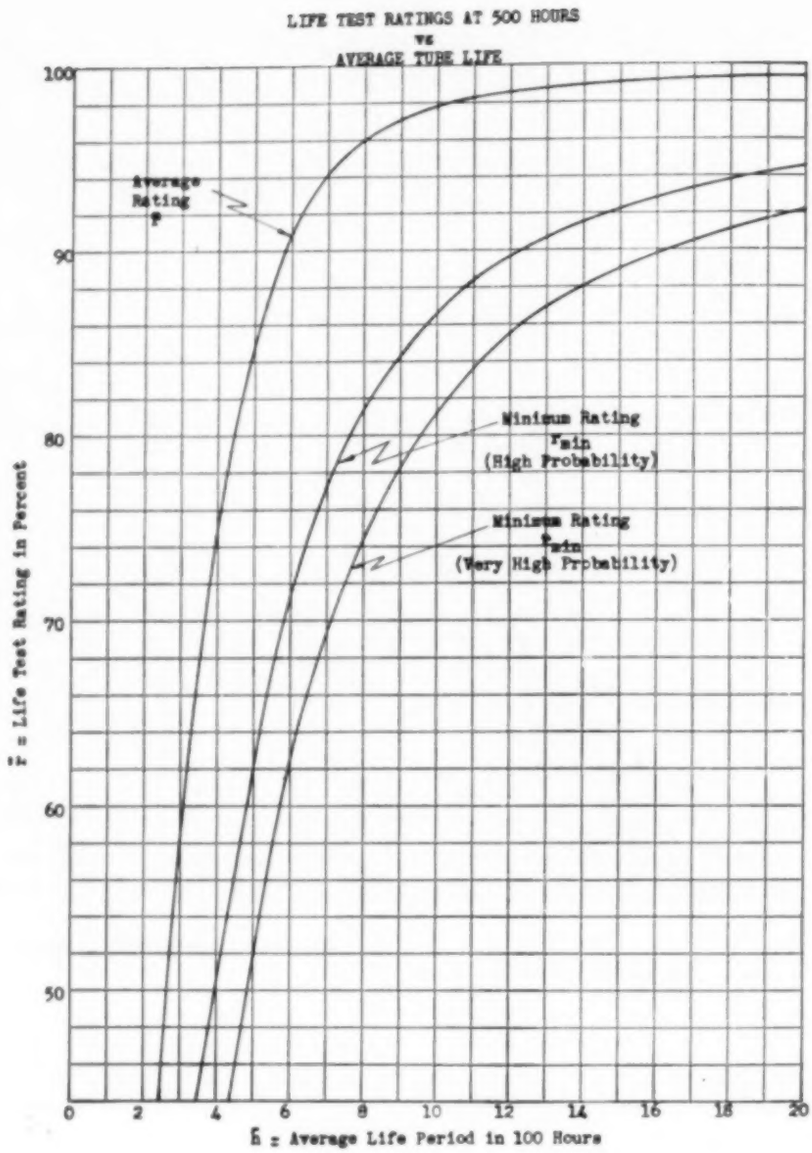
Taking into consideration sampling fluctuations, two Minimum Rating Curves are presented in Fig. 4. One curve, based on computations involving $3\sigma_p$ corresponds to a "Very High Probability" value, and the second, based on computations involving $2\sigma_p$, corresponds to a "High Probability" value, although neither of these probability values is known. The device used for computing these two curves was to determine the $\pm 3\sigma_p$ and the $\pm 2\sigma_p$ values about each combination of p_i values determined for any given distribution of $\bar{h}$. Corresponding to t_i — 500 — t_7 the corresponding p_7 used in these determinations is the minimum value derived from the above calculations, either $p - 3\sigma_p$ or $p - 2\sigma_p$, depending upon which probability value is under consideration. Correspondingly, for t_1 — 10, p_1 is taken as a maximum value allowing for the sampling fluctuations indicated by the addition to the p value of the time interval involved, either $3\sigma_p$ or $2\sigma_p$. The same procedure was followed for p_2, p_3, p_4, and p_5. Since the sum of the values of p_i would exceed 1.000 if a corresponding maximum value p_6 were used, in order to avoid this difficulty, p_6 was arbitrarily adjusted and given a value such that the sum of the p_i values would be exactly 1.000. This procedure was used for the series of eight $\bar{h}$ distribution values shown in Fig. 3, and provided the information for plotting the Minimum Rating curves shown in Fig. 4.

The range is related to the minimum rating by definition as R — 100 — r_{min} for all values of tube-life. Actually the range should be r_{max} — r_{min}, but the Maximum Rating calculated for average life periods in excess of 500 hours is 100%. Hence, 100% is used in the range equation instead of r_{max}. Actual data support this substitution.

Consequently, for any tube-life period the average rating and the two minimum ratings may be read from the curves of Fig. 4. Using these values a plot of (100 — r_{min}) vs. $\bar{r}$ was prepared giving the graphical relation between R and $\bar{r}$ as shown in Fig. 5. The R (High Probability) curve was modified in the region $98.0 \leq \bar{r} \leq 100.0$ to account for the practical case of high average ratings which consist of 9 ratings of 100% and the remaining one at r_{min}, i.e. when r_{min} — 10 $\bar{r}$ —900.

The empirical curve R vs. $\bar{r}$ shown in Fig. 5 was obtained by fitting a curve to the 231 points of $\bar{r}$, R derived from actual data covering more than 2,300 life test samples combined in groups of ten ratings. The same set of data was used in checking the application of this method, and it indicated that the probabilities associated with the plan were of a very high order, so that very little risk of releasing unsatisfactory quality product was taken by the application of these various rating acceptance plans.

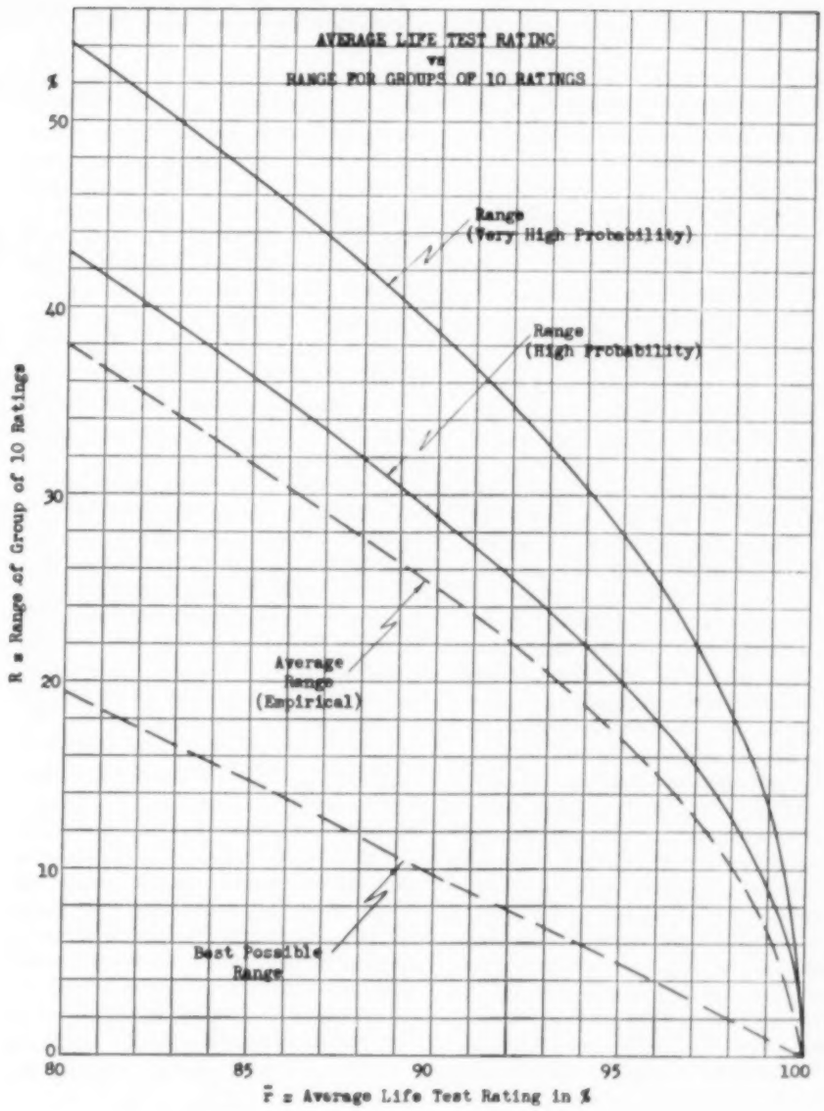
FIGURE 4



In standardizing the release method into a preselected number of Rating Plans, it was necessary to establish criteria for groups of $\bar{r}$, R combinations. Using both $\bar{r}$ and R with equal weight involves a division of the $\bar{r}$, R plane by lines of unit slope. The number of such lines to be drawn as dividing lines is evidently one less than the preselected number of Rating Plans. It was decided to establish six plans, such that each one starts its production release at one of the reading periods 16, 42, 84, 126, 275, or 500 hours. Then five lines are required and it was necessary to establish the location of these dividing lines. Using the curves of Fig. 5 as a guide it was found that the range curve corresponding to a "Very High Probability" value provided a value $\bar{r}$ = 98% when R = 20%. The choice of 20% seems appropriate since the specified tolerance at 500 hours is 80%. Taking a value midway between the Very High Probability curve and the High Probability curve, an $\bar{r}$ value of 96.5% was found corresponding to R = 20%. This procedure was continued in two similar equal steps below the High Probability curve giving also $\bar{r}$ = 95% for R = 20% and $\bar{r}$ = 93% for R = 20%. This last value corresponds very closely to the empirical curve for the Average Range. These five values of $\bar{r}$, R when plotted on Fig. 2 may be roughly connected by a straight line. Five lines may be passed through these respective five points with slopes such that the lines are practically perpendicular to this rough line connecting these five points. In actually drawing these lines slightly more refined methods were used, but this indicates the nature of the procedure followed.

Table 1 gives the criteria which are to be applied to these six Rating Plans. These values were based on several empirical choices involving the determination of value of r_{min} at various reading periods. These values were so selected that little risk was taken of accepting an unsatisfactory lot on the basis of the rating obtained at an early reading period. No definite probability values can be assigned to these criteria, but they are of a nature such as to be very much on the safe side. Experience has indicated that their choice was at least good enough. From the point of view of economy the selection might be made in another manner resulting in earlier release of poorer quality product without increasing the risk beyond the economical level. More refined statistical methods would have to be applied in order to determine probabilities associated with more liberal criteria.

FIGURE 5



Conclusion

Full use of the release method saves a three weeks' holding period for a high percentage of all production as well as eliminating much handling and storage space problems. As applied, this percentage was over 90%, and the records show more than 99% accuracy for over a year's usage.

Clerical work is minimized by use of the chart and table. A complete tabulation, computation and selection of proper Rating Plan for each re-rating is easily performed in one minute per tube type. The computation form can be used for 35 weeks at the rate of one rating per week. This provides for about a year's record, assuming the type is in production approximately 2/3 of the time.

This simplicity of use together with the time and storage savings definitely marks the early release method as a production expediter with quality control.

Editorial

With this issue, INDUSTRIAL QUALITY CONTROL presents the results of the first full-scale efforts of its new editorial chairman to follow in the footsteps of its founder and first editor, Dr. Martin A. Brumbaugh. It appears appropriate if, indeed, not actually expected, that the new chairman should take this occasion to speak directly to the readers of the magazine.

It may be safely assumed that your new editor is fully aware of the fine heritage that has been transferred to him, and of the very real responsibilities that go with the office. It would be equally foolish to suppose, either that he intends to break with precedents already set for the magazine, or that he is so unimaginative as to believe that no further improvements are possible. With the high calibre of talent available to the magazine on its editorial board, and with steadily maturing experience among the readers of INDUSTRIAL QUALITY CONTROL, future volumes must record a steady growth in the character and diversity of published material that will reflect the advance and expansion of statistical quality control theory and techniques, while at the same time faithfully maintaining the role of interpreter of these techniques in concrete, operational terms capable of being translated to direct, practical application in industrial situations. Any other program would defeat the very purposes INDUSTRIAL QUALITY CONTROL is intended to serve and render a distinct dis-service to the objectives for which the American Society for Quality Control exists.

In this connection, one of the foremost problems confronting your chairman and editorial board is the question of balance in the type of papers published. To maintain its proper place as a professional journal, INDUSTRIAL QUALITY CONTROL must strive to serve faithfully the very wide range of interest that exists among its readers. It is not possible to do this consistently until a reserve of completely processed papers is on file to provide for a selection that will approximate a balanced presentation as the deadline for each issue arrives. Older, well-established journals in the technical field have ample back-logs of papers from which to choose in making up each issue. As a relative new-comer in this field, INDUSTRIAL QUALITY CONTROL is not yet in this enviable position, and, until it is, the magazine must, of necessity, fall somewhat short of the potential reader-service it could render.

The time between the initial receipt of a paper and its eventual availability for publication may run all the way from one to six months or more, depending on the amount of editing and revision required to insure its technical correctness and its presentation in a clearly written, readable form. It follows that just to get out one issue—to say nothing of "balance"—requires the existence of a considerable surplus of papers "in process." Hence, if INDUSTRIAL QUALITY CONTROL is to measure up to its full potential as a professional journal, it is essential that a reserve of completely processed papers be created and maintained. Otherwise the magazine will have to carry in each issue just what is ready to go at that time, and, clearly, performance on such a basis cannot mean operation in a "controlled" sense!

Furthermore, this whole question of having available a back-log of processed papers from which to draw, ties in closely with the problem of getting the magazine out on schedule. Rigid deadlines, and hence, punctuality in publication, can be anticipated once there exists a reserve of completed papers with which to meet such deadlines.

All of which comes down to this: your editorial chairman and board earnestly solicit active reader participation and alertness in channelling to INDUSTRIAL QUALITY CONTROL material which can be considered for publication. As Dr. Brumbaugh pointed out in an earlier editorial, it is a mistake to suppose that a paper has to be concerned with some new development to merit consideration. Such papers are, of course, needed and welcome, but successful and interesting applications of standard techniques very often have reader value far beyond what the man who made the application may imagine. If a paper you have heard, or an application of which you know, has interest for you, it should certainly be a candidate for publication in your magazine. A note to the editorial office indicating how contact can be made is all that is necessary. In return for such wholesale response, on a continuing basis, as is here requested, your editor can promise a magazine that will enlarge upon the reputation for interest and usefulness already established by the preceding three volumes, and that will reach you with dependable regularity.

Mason E. Wescott.

CONFERENCE PAPERS REPRINTED

The book **Conference Papers**, containing in full the text of 29 of the 38 papers presented at the joint Convention and Conference in Chicago, June 5-6, proved to be one of the unique features of these meetings. The original printing of 950 copies has now been exhausted, and orders are still coming in. In order to supply the needs of the many persons who have not yet been able to secure a copy, or who may want additional copies, arrangements have been made for reprinting 500 more copies.

Sale of these additional 500 books will be handled by the American Society through the office of its Treasurer at the regular price of $3.50 (post-paid) per copy. Send your order and remittance to: Alfred L. Davis, Treasurer, Rochester Institute of Technology, Rochester 8, N. Y.

Conference Papers has been widely accepted as a unique and interesting contribution to the literature of statistical quality control. It presents a cross-section coverage of current quality control theory and practice in a wide range of industrial applications, and deals with a variety of topics touching almost every phase of quality control activity from top management down to the humblest beginner.

Report of First Convention
American Society for Quality Control
AND
Second Mid-West
Quality Control Conference

The first convention of the American Society, held at the Hotel Sherman in Chicago on the 5th and 6th of June in conjunction with the Second Midwest Quality Control Conference, was altogether the success that those who had worked so hard to achieve it had hoped it would be. Over 2,000 persons in all were present at one time or another during the two day program of clinics, luncheons, dinner, and exhibits. The largest group naturally came from the midwest area, but 54 came from New York, 46 from Pennsylvania, 21 from New Jersey, and there were scattered registrations from most of the other states and several from Canada.

Final auditing has not yet been completed, but total receipts amounted to approximately $22,000 and total expenditures to approximately $18,000. Refunds for advances by participating Midwest Sections, together with a Founding Contribution of $1,000 to the A.S.Q.C., have already been made.

Many of the thirty-five clinical sessions had upwards of 200 interested auditors, the top figures being about 300 and 500 respectively. Nearly 700 persons registered for the entire two days program, and attendance at each of the general luncheon and dinner meetings ranged from about 600 to about 900.

Twenty-six gage and other manufacturers, including several firms of quality control and management consultants, presented most interesting demonstrations of their specialties in the Exhibit Hall. All exhibitors expressed pleasure with the attendance and interest shown in their products. One wrote the following comments (which are typical of what several of the exhibitors stated)—"The sales and interest shown exceeded our expectations. We want to reserve exhibit space for your next Convention, as we know of no other group of Chief Inspectors and Production Engineers, which we are trying to reach through any other method, that would excel your own group of men."

The facilities of the Hotel Sherman were admirably adapted to the handling of the Convention, and the Hotel Management surpassed itself in the thoughtful and efficient way in which it met the needs and desires of those in attendance. Such difficulties as were experienced by members in securing rooms were largely the result of failures to make advance registrations. The few instances where such inconvenience resulted from errors were serious to the individuals involved, but almost neglible in comparison with the total served.

The text of most of the papers presented at the general and clinical sessions was included in a bound volume of **Conference Papers** which was on sale during the two day meetings. Elsewhere in this issue there is a notice describing how copies of this book may be secured by those not in attendance at the Conference, or who may want additional copies.

Those who attended the several sessions of the Convention left it almost uniformly with the feeling that they had taken part in a noteworthy if not epoch-making event in quality control history, and that they had profited much from it. In the process they had had opportunity to renew old friendships, to make new ones, and to have an all round good time.

CLINICAL SESSIONS

The thirty-five clinical sessions were extremely varied in subject matter, and offered examples of the application of quality control in almost every major type of industry. The speakers at the clinics were almost uniformly expert in their fields, and they provided a wealth of factual and illustrative information. The large and attentive audiences which they attracted gave ample evidence of their uniform success.

LUNCHEON SESSION 5TH JUNE

The first luncheon session was sponsored jointly with the Chicago Association of Commerce and Industry, and approximately 800 people were in attendance. The session was opened with a few introductory remarks by Mr. Edward D. Thompson, Assistant to the President of Ontario Manufacturing Company, and General Chairman of the Conference Planning Committee. Mr. Thompson then introduced Mr. Leverett S. Lyon, Chief Executive Officer of the Chicago Association of Commerce and Industry.

Mr. Lyon welcomed the American Society to Chicago, and extended the best wishes of the Association for a successful Convention. He presented Mr. David Levinger, Vice President and Hawthorne

Works Manager of the Western Electric Company, who acted as Chairman of the session. Mr. Levinger expressed his pleasure at being asked to preside over such a large and representative meeting of people gathered together for the purpose of promoting quality control. He touched upon the long and successful history of quality control applications in his own company, and expressed his great satisfaction with their effectiveness.

Mr. C. R. Sheaffer, President of the W. A. Sheaffer Pen Company, had been scheduled as the principal speaker at this session, and his subject had been programmed as **What Top Management Expects From A Quality Control Program.** Mr. Levinger announced that unavoidable circumstances had, at the last moment, prevented Mr. Sheaffer from coming to Chicago, and he introduced instead Mr. A. B. Howard, Works Manager of the W. A. Sheaffer Pen Company, who presented Mr. Sheaffer's paper for him. The paper has been included, in its entirety, in the bound volume of **Conference Papers,** and it will not be reviewed here. Mr. Howard's presentation of it elicited much favorable comment, and the session was generally agreed to have been a most satisfactory and successful one.

DINNER SESSION 5TH JUNE

The dinner meeting was the main Convention session of the American Society, and was attended by approximately 900 members and guests. On the dias, in addition to the speakers and the officers and guests of the Society, were many of the Directors and General Committee Chairmen, the Chairmen of most of the Convention Committees, and the Chairmen or Presidents of a number of Sections. Mr. Thompson again opened the session and presented as Chairman of the meeting Mr. George D. Edwards, Director of Quality Assurance of Bell Telephone Laboratories and President of the American Society.

In his opening remarks, Mr. Edwards called attention to the fact that this was the first truly national meeting of the American Society for Quality Control, and in fact the first really representative nationwide gathering of any kind for quality control people. He mentioned the handsomely engraved gavel which had been presented to him by the Hotel Sherman Management, and took opportunity to express the appreciation of the Society for the fine care which the Hotel was taking of the Convention.

Mr. Edwards then proceeded to introduce individually each of the Officers, Directors, and Committee and Section Chairmen seated on dias, and each was greeted with a round of applause as he arose in acknowledgment. In the course of this, Mr. Edwards paid special tributes to: Mr. Ralph E. Wareham, Executive Secretary of the Society; to Mr. Alfred L. Davis, Treasurer of the Society; to Mr. Edward D. Thompson, General Chairman of the Convention Committee; to Mr. Fred J. Halton, Jr., Mid-West Regional Director; to Mr. Charles J. Hudson, New England Regional Director; and to Mr. Ernest H. Robinson, Executive Chairman of the American Society Committee on Publicity and Public Relations, and President of the Chicago Section. To all of these, and to the many others who had labored faithfully in preparation for the Convention, Mr. Edwards extended the thanks and appreciation of the Society.

In connection with his introduction of Dr. Martin A. Brumbaugh, Chairman of the Editorial Board, Mr. Edwards announced with sincere regret Dr. Brumbaugh's resignation from these duties effective 1 July. Following a few words in glowing tribute, he called for a rising vote of appreciation to Dr. Brumbaugh for the very large contribution which his efforts had made to the Society and to its magazine. The vote was given unanimously with enthusiasm and applause.

Mr. Edwards then introduced Professor Mason E. Wescott of Northwestern University, and announced that the Board of Directors had that afternoon unanimously confirmed appointment of Professor Wescott to succeed Dr. Brumbaugh as Chairman of the Editorial Board. Professor Wescott was greeted with applause.

In a little ceremony which is more fully recorded elsewhere in this issue of the magazine, Mr. Edwards then introduced Dr. Walter A. Shewhart, presented him with Honorary Membership in the Society, and announced the foundation of the Shewhart Medal.

Mr. Edwards then presented a brief report of the progress and accomplishments of the American Society during its first year, and its aims for the immediate future. His report concluded with a statement regarding the proposed new constitution for the Society, and he stressed particularly the need for increased income from dues and the consequent duty of members to transfer to the highest grade of membership for which they may individually be eligible.

This completed the first portion of the program for the session, and there followed the main speaker of the evening, Mr. George F. Smith, President of Johnson and Johnson, New Brunswick, New Jersey. In introducing Mr. Smith, Mr. Edwards touched upon his rapid rise to the Presidency of his Company, his many outside interests, and his belief in and support of quality control. He referred to Mr. Smith also as "a quality control philosopher in his own right," and as "a thinker and reasoner along economic and business lines from whom the best can learn much."

Mr. Smith's discussion of **Management's Viewpoint of Quality Control** has been included in full in the bound volume of **Conference Papers,** and it will not be reviewed here. It was enthusiastically received by the entire audience, and can only be described as an outstanding highlight of the Convention.

Following Mr. Smith's talk, Mr. Thompson asked for the floor and presented to Dr. Shewhart, to Mr. Edwards, and to Professor Wescott, copies of the bound volume of **Conference Papers.** Each paper in each of these three copies had been individually autographed by its author, and the recipients were obviously delighted with them.

Mr. Thompson then called upon Mr. Halton, who presented to Mr. Edwards on behalf of the Society a scroll signed by the Chairman or

President of each of its twenty-five Sections. This scroll expressed to Mr. Edwards the thanks and appreciation of the Sections for his leadership and for his continued and effective effort on behalf of the Society during its first year. In accepting the scroll, Mr. Edwards expressed his sincere thanks to Mr. Halton and to all of the members of the Society for this evidence of their regard for him.

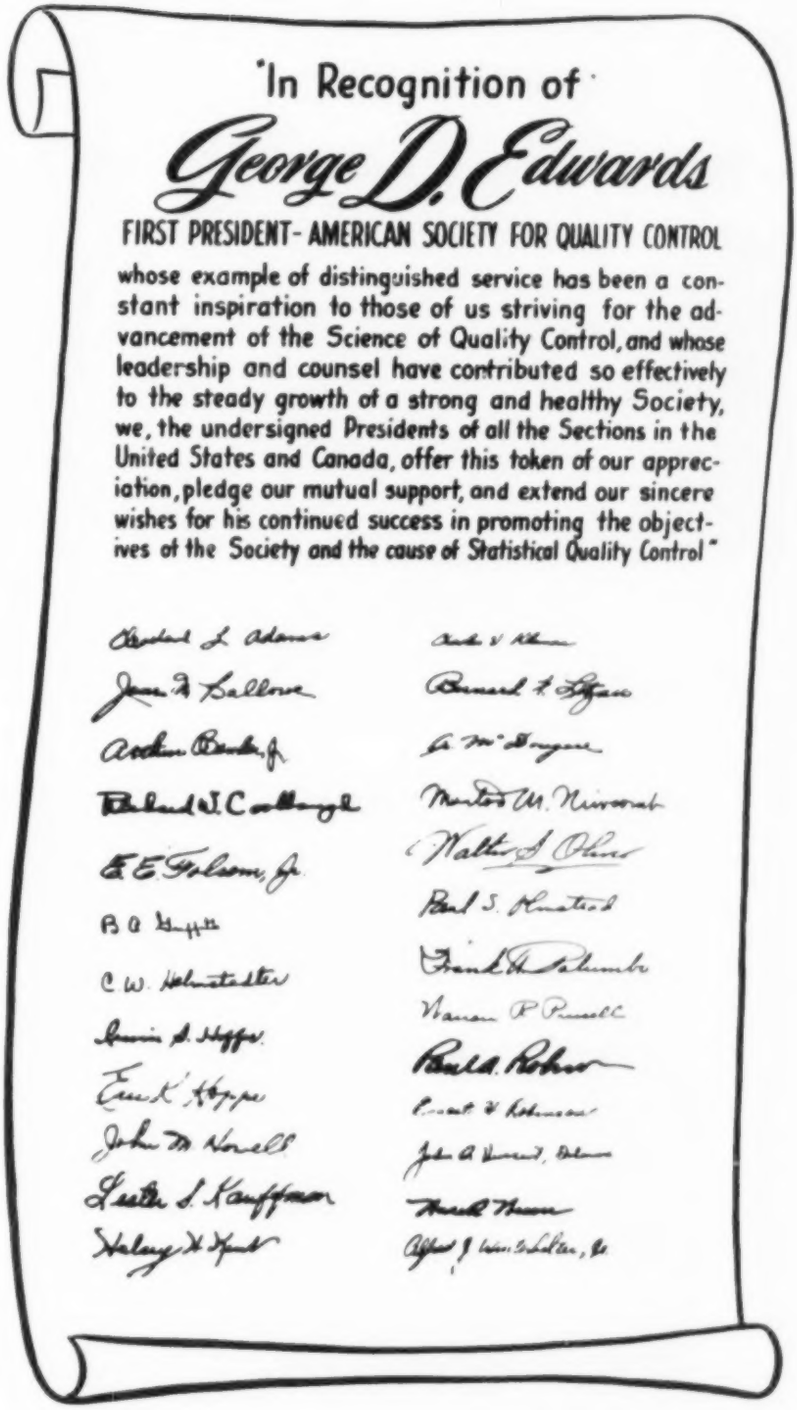
Attention was then called to the final item on the program for the session, which was listed merely as **A Feature.** This turned out to be a color sound picture entitled **Modern Quality Control,** which had recently been completed by the Johns Manville Corporation. It had been listed in this way on the program only because there had been no certainty, until a few days before the meeting, that it could be ready in time to be shown. Mr. Edwards introduced Mr. S. Collier, Director of Quality Control of the Johns Manville Corporation, who described the plan and objectives of the pictures and presented it to the meeting.

The picture was extremely well planned and photographed, and was most effective in explaining the fundamental principles and procedures of quality control from a lay point of view. It was enthusiastically applauded by the entire audience, and excited many favorable comments throughout the remainder of the Convention period. In thanking Mr. Collier and the Johns Manville Corporation for presenting the picture to the Society, Mr. Edwards assured him "that you and your Company have every reason to be proud of the picture, and that it will be most effective in selling quality control and Johns Manville."

The session was then adjourned with a feeling on the part of all present that it had been an outstanding success.

LUNCHEON SESSION 6TH JUNE

The second luncheon session was the general meeting of the Midwest Quality Control Conference, and approximately 600 people were present. Mr. Thompson presided as General Chairman, and the


In Recognition of
George D. Edwards
FIRST PRESIDENT - AMERICAN SOCIETY FOR QUALITY CONTROL
whose example of distinguished service has been a constant inspiration to those of us striving for the advancement of the Science of Quality Control, and whose leadership and counsel have contributed so effectively to the steady growth of a strong and healthy Society, we, the undersigned Presidents of all the Sections in the United States and Canada, offer this token of our appreciation, pledge our mutual support, and extend our sincere wishes for his continued success in promoting the objectives of the Society and the cause of Statistical Quality Control"

CONVENTION PICTURES

E. D. Thompson — George D. Edwards

George D. Edwards — George F. Smith

Fred Halton presenting Scroll to George D. Edwards

speaker was introduced by Mr. Frank A. Palumbo, Chairman of the Program Committee. Mr. R. W. Jackson, President of Alden's, Incorporated, was the speaker for the session, his subject being **Quality Control at Alden's.**

Mr. Jackson's paper has been included, in its entirety, in the bound volume of **Conference Papers,** and will not be reviewed here. That his presentation was clear, convincing, and helpful, is attested by the enthusiasm with which it was received, and by the many favorable comments and discussions which it elicited during the remainder of the Convention.

BOARD AND COMMITTEE MEETINGS

The following American Society Boards and Committees held productive meetings in Chicago at various times during the two days of the Convention:

Board of Directors
Editorial Board
Committee on Constitution and By Laws
Committee on Professional Ethics and Qualifications
Committee on Membership
Committee on Programs and Speakers
Committee on Publicity and Public Relations
Committee on Relations with Educational Institutions.
Committee on Relations with Technical Societies

The principal decisions reached at the meeting of the Board of Directors are reviewed under American Society News in this issue of the magazine.

Dr. Shewhart Honored

PRESENTED WITH HONORARY MEMBERSHIP
FOUNDATION OF SHEWHART MEDAL ANNOUNCED

. At the dinner meeting of the American Society for Quality Control in Chicago on Thursday, 5 June, held in connection with the First Convention, Honorary Membership in the Society was conferred on Dr. Walter A. Shewhart, and foundation of the Shewhart Medal was announced.

In making the presentation and announcement, President Edwards introduced Dr. Shewhart as "The Inventor of Quality Control", and spoke as follows:

"On the 16 May, 1924, just a few days over 23 years ago, Dr. Shewhart prepared a little memorandum only about a page in length. About a third of that page was given over to a simple diagram which we would all recognize today as a schematic control chart. That diagram, and the short text which preceded and followed it, set forth all of the essential principles and considerations which are involved in what we know today as process quality control.

"While Dr. Shewhart is known to all of us as one who grasps the fundamentals,—the essentials,—in such matters, his modest and retiring disposition has tended to obscure, perhaps, the enormous contribution which that little memorandum has made to American industry, and for which we are all so largely indebted to him.

"It was but natural that he should be unanimously the first selection of our Executive Committee for membership on the Advisory Council of the American Society for Quality Control, and he graciously accepted appointment.

"We have invited him to be our guest here this evening so that we may honor him in our small way as our mentor, and in a sense if you will,—our patriarch. But he has honored all of us even more, by consenting to come.

"Dr. Shewhart:

"In token of our sincere appreciation of your great accomplishments for quality control, and thus for the cause to which our Society is dedicated, our Board of Directors has unanimously elected you the first Honorary Member of the American Society for Quality Control, and I am happy to present to you this evidence of such membership in token of the great esteem in which we all hold you.

"It is our intention that our company of Honorary Members shall grow slowly over the years. If this is to be the case, we shall of course be unable to limit it to people whose contribution to quality control has equalled yours. But we expect it will remain a company, each of whose members even you will readily recognize as having made such an outstanding contribution to quality control, as to warrant inclusion in such a select group.

"It is also my pleasure to announce at this time that our Board of Directors has unanimously established the **Shewhart Medal Foundation.** This medal is to be awarded not oftener than once each year to a person selected by the Shewhart Medal Committee who has made a suitably outstanding contribution to the cause of Quality Control. When the Committee has chosen an acceptable design for the medal, you will be presented with the first example struck from it, as evidence of our affectionate regard for you and of our best, though inadequate, efforts suitably to honor you.

"Ladies and Gentlemen:
Dr. Shewhart."

In responding, Dr. Shewhart said that he accepted the honor conferred on him with much appreciation. He congratulated the Society on the striking success of its first Convention and on the remarkable progress which it had made during its first year in many other ways. He expressed the conviction that the Society could be a very large and effective force for the advancement of quality control, and that quality control and the Society would go forward to new triumphs during the years to come.

The entire audience then stood amid unanimous applause.

AMERICAN SOCIETY NEWS

BOARD OF DIRECTORS MEETING

The first formal and official meeting of the Board of Directors, since organization of the American Society, was held at the Hotel Sherman in Chicago on Thursday, 5 June, 1947, the first day of the Society's Convention. Informal meetings of members of the Board had been held on a number of earlier occasions during the year, but it had not previously been possible to secure a quorum.

The following members of the Board were present at the June meeting:

George D. Edwards, President

Ralph E. Wareham, Executive Secretary

Alfred L. Davis, Treasurer

Martin A. Brumbaugh, Chairman, Editorial Board

Charles J. Hudson, Boston

Alfred J. Winterhalter, Buffalo

Ernest H. Robinson, Chicago

Ralph A. Hefner, Georgia

Frederick J. Halton, Jr., Iowa

Bernard F. Litzau, Milwaukee

Kieth E. Ross, Northeastern Indiana

Wade R. Weaver, Ohio

Earl W. Mahaney, Pittsburgh

Halsey H. Kent, Rochester

L. S. Kauffman, St. Louis

Richard W. Coolbaugh, Syracuse

The Executive Secretary presented a report showing the steady growth of the Society's membership from its formation to the total of 1,821 as of 27 May, 1947. The Treasurer's report showed a balance on hand of $2,837.41 as of 1 June, 1947. Both reports were accepted as presented.

An important portion of the meeting was devoted to review and approval of the more important items acted upon by the Executive Committee in the course of the year.

The resignation of Dr. Martin Brumbaugh as Chairman of the Editorial Board was accepted with sincere regret, and the President's appointment of Professor Mason Wescott, to succeed Dr. Brumbaugh on 1 July, 1947, was unanimously confirmed.

Appointment of the Auditing Committee, and setting of the time and place for the Annual Meeting, both of which actions had already been approved by the Executive Committee, were also unanimously confirmed.

The President reported action of the Executive Committee recommending election of Dr. Walter A. Shewhart to Honorary Membership in the Society, and foundation of the Shewhart Medal to be awarded to persons elected for their outstanding contributions to the advancement of quality control.

Dr. Shewhart was thereupon unanimously elected the first Honorary Member of the Society. A resolution was also unanimously adopted authorizing the President, with the approval of the Executive Committee, to appoint a Shewhart Medal Committee having the following authority:

1. to select and appoint not more than one Medalist each year, the first appointment to be made not earlier than 1948;

2. to select and approve a suitable design for the Medal;

3. to order, with the approval of the Executive Committee, two examples of the Medal, one to be presented to Dr. Shewhart in testimony to the high regard in which the Society holds him, and the other to be presented to the first Medalist;

4. to handle any other matters involved in administration of the Shewhart Medal Foundation, all items requiring expenditures to have concurrence of the Executive Committee in advance.

The Board reviewed the status of the new Constitution as recommended to the Society by the Executive Committee, the Committee on Constitution and By Laws, and the Committee on Professional Ethics and Qualifications. A resolution was unanimously adopted by the Board, endorsing the new Constitution as proposed, and urging its adoption by the Society.

Several members of the Board mentioned a tendency on the part of members of their Sections to renew their American Society membership for 1947-48 in the Member grade rather than in the Senior Member grade. The Board members present at the meeting uniformly recognized the serious financial difficulties which would beset the Society during the coming year if this practice were to become at all widespread. The Board placed itself on record as in general opposed to this practice in cases where the member involved is eligible to the Senior Member grade. Each Board Member present undertook to acquaint the members of his Section with the reasons behind the position taken by the Board.

The President presented to the meeting certain information with respect to the effect of collective bargaining on professional people employed in industrial plants. He felt this might be helpful to Board members in case they were questioned regarding the status of A.S.Q.C. members in such matters, or regarding the help which the Society could hope to offer its members in such matters.

The President also presented to the Board several criticisms which had come to him regarding solicitation of individual gage manufacturers for exhibits at three or four Sectional or Regional Meetings of the Society in a single year. The matter elicited substantial discussion from various members of the Board, but action with regard to it was postponed for consideration by the new Board.

There followed some discussion as to whether the Society was securing as much advertising in the magazine as should properly be expected. The Board reached no conclusion as to the answer to this question, although the members were unanimous in their wish that more advertising could be secured. Administration of the advertising contract was left in the hands of the officers, questions of major policy to be determined by the Executive Committee as occasion may arise.

There being no further opportunity for a meeting of this Board, adjournment was sine die.

ANNUAL MEETING—1947

The first Annual Meeting of the American Society for Quality Control was held at the Engineering Societies Building in New York City on Friday afternoon, 27 June, 1947.

President Edwards called the meeting to order at 2:10 P.M., and immediately appointed Mr. Elwood E. Folsom, Jr. of the Southern Connecticut Section, Mr. David H. Schwartz of the Metropolitan Section, and Mr. William H. Graham, Member At Large, as Judges of Election.

Executive Secretary Wareham reported that 1821 postal ballots had been sent out to the membership the required thirty days in advance of the meeting, and that 801 of these had been returned to him up to the time of the meeting.

The President inquired whether there were any members present who had not voted by mail and who wished to cast their ballots in person. The Executive Secretary distributed ballots to 2 such members, and these were collected in due course by the Judges. The Executive Secretary then turned over to the Judges the 801 ballots which had been cast by mail, and the Judges retired to make their tally.

The President then stated that he was prepared, on behalf of the Board of Directors, to present a report on the progress and accomplishments of the Society during the period from its organization until this first Annual Meeting. He suggested however, that this report would be very similar to those which he had presented at several recent meetings of Sections and at the Convention Dinner meeting in Chicago on 5 June, and that the great majority of those present had therefore heard the equivalent of most of it. He accordingly indicated his readiness to entertain a motion that his report be accepted without presentation. A motion to this effect was passed without objection.

The Executive Secretary presented, on behalf of the Board of Directors, a report on the general status of the Section and Membership Rolls, showing 25 Sections and 1,838 Members in good standing as of the date of the Annual Meeting. Of the total membership, 234 were Founding Members.

Treasurer Davis presented, on behalf of the Board of Directors, a summary income and expense report showing a balance of $2,607.33 on hand as of the date of the Annual Meeting. A tentative balance sheet, presented as of the same date, showed a net excess of assets over liabilities of $2,701.67. There was some discussion of the basis on which the stock of back issues of the magazine had been inventoried, and it was agreed that decision as to the soundness of this basis was a duty of the Auditing Committee.

On motion duly made and seconded, the reports of the Executive Secretary and of the Treasurer were ordered accepted as presented. The reports of all three officers were also ordered to be extended as necessary to include the whole of the fiscal year, and, after proper certification of the Treasurer's Report by the Auditing Committee, to be published in the September issue of Industrial Quality Control.

The Judges of Election then presented their report to the President, who discharged them with the thanks of the Society. Their report was read to the meeting by the Executive Secretary, as follows:

Total Ballots Cast By Mail	801
Total Ballots Cast In Person	2
Total Ballots Cast	803

Vote For Officers

Total Ballots Cast	803
Disqualifed and Invalid Ballots	12
Net Qualified and Valid Ballots	791

Vote For President

For George D. Edwards	781
For All Other Candidates	6
Not Voted	4

Vote For Vice President

For Frederick J. Halton, Jr.	773
For All Other Candidates	11
Not Voted	7

Vote For Executive Secretary

For Ralph E. Wareham	786
For All Other Candidates	2
Not Voted	3

Vote For Treasurer

For Alfred L. Davis	782
For All Other Candidates	3
Not Voted	6

Vote On Constitutional Amendments

Total Ballots Cast	803
Disqualified And Invalid Ballots	18
Net Qualified and Valid Ballots	785
For Adoption of Amendments	739
For Rejection of Amendments	12
Not Voted	34

Messrs. Edwards, Halton, Wareham, and Davis, each having received a plurality of the valid ballots cast for the several offices involved, were declared by the President duly elected or reelected to the respective offices for which they had been nominated.

The Constitutional Amendments, in the form submitted to the membership with the Executive Secretary's letter of 27 May, 1947, having received more than the two-thirds affirmative votes required by the Constitution and By Laws, were declared by the President duly adopted and effective as of 1 July, 1947.

Mr. Edwards then thanked the membership for the compliment paid him by his reelection. He pointed out that he had done his best, without success, to persuade the Nominating Committee of the wisdom of selecting some other nominee for the presidency during the coming year. He had finally yielded to the weight of the pressure which had been brought to bear on him from the Nominating Committee and from other sources, but he made quite clear his conviction that long-continued terms in the presidency were not to the best interest of such Societies, and that this exception to such a rule must be the last in which he could have a part.

In accepting the presidency again, Mr. Edwards indicated that he interpreted his reelection as at least general endorsement by the membership of the policies adopted in the administration of the Society during the year just past. He pledged his best efforts for the continued advancement of the Society during the year to come.

Mr. Edwards noted the absence of the Vice President-elect and directed the Executive Secretary to address a suitable letter to Mr. Halton extending the compliments of the Society, notifying him of his election to the vice-presidency, and transmitting the Vice President's badge to him.

Messrs. Wareham and Davis expressed to the meeting their appreciation of the honor paid them by the Society in their reelection, and they promised their continued best efforts in behalf of the Society during the coming year.

The President then presented to the meeting a brief discussion of the financial status of the Society, and pointed out that the only way its activities can be maintained, requires that a substantial proportion of those eligible shall transfer promptly to a higher grade of membership. Practically the entire present roll of the Society is eligible to Senior Membership. If half of those eligible are willing to show their loyalty and support by transferring, the problem is solved. If the dues income of the Society is not augmented to this extent, the resulting necessary curtailment of its activities will mark the beginning of its decline.

Mr. Edwards concluded by emphasizing that the officers have not accepted reelection in order to be plagued by financial worries, and that he felt this small evidence of support from the membership was the minimum which they might properly expect. His remarks provoked considerable discussion from the floor and elicited substantial evidence of support from the membership.

The President then produced an envelope which he had received by mail the day before from the Mid-West Quality Control Conference, and which contained a sealed envelope marked: "To Be Opened At The First Annual Meeting Of The American Society For Quality Control."

Upon opening this second envelope at the meeting, it was found to contain a letter from Mr. Edward D. Thompson, General Chairman of the Conference, transmitting an additional Founding Contribution of $1000 to the American Society from the Sections of the Mid-West Region. Mr. Edwards read the letter to the Meeting and it was received with enthusiastic and appreciative applause. A resolution was passed unanimously requesting the President to write Mr. Thompson expressing the thanks and appreciation of the Society to the Sections in the Mid-West Region for this most helpful and acceptable material evidence of their loyal and generous support.

Messrs. Wade R. Weaver and Charles J. Hudson asked, in turn, for the floor to express for the Society, and for themselves, appreciation for the unmeasured and successful efforts of the officers in guiding the Society through its first year. Their remarks were greeted with applause.

There being no further business to come before the meeting, adjournment was taken at 3:05 P.M.

YEAR-BOOK 1946-47

The American Society Year-Book for 1946-47 has now been mailed to all of the members listed therein (listing supposedly up to date as of 1 April, 1947). In addition, it has been mailed to all members joining the American Society after 1 April, 1947 who have paid dues for any portion of the year 1946-47. Because of the limited number of copies printed, the Year-Book cannot in general be supplied to 1947-48 members who have not paid dues for any portion of the year 1946-47.

Any American Society member who should have received a copy of the Year-Book on the above basis, and who has not received one, is urged to communicate with the Executive Secretary so that the error may be traced and rectified. The Year-Book cannot in general be supplied to non-members.

Members are urged to read carefully the statement on page 2 of the Year-Book, with regard to the use of the membership list which it contains, and to guide themselves strictly in accord therewith.

Members are also urged to check carefully the listing of their names in the Year-Book, both in the Alphabetical Index of Members beginning on page 27 and in the Catalogue of A.S.Q.C. Sections beginning on page 39, and to inform the Executive Secretary promptly of any errors or omissions in the listings. The Executive Secretary will also appreciate being informed of any other errors or omissions which may be noted, so that all may be corrected so far as possible in the 1947-48 Year-Book.

Secretaries and other Officers of Sections are requested to check carefully all information contained in the 1946-47 Year-Book referring to their several Sections, and to notify the Executive Secretary promptly of any errors which they may discover. It is suggested that particular checks be made between Section membership records as of 1 April, 1947, and the Section membership totals recorded in the Index of A.S.Q.C. Sections. Founding Membership notations may well be checked at the same time.

It is recognized that errors and omissions may well have crept into the Society's records during this first year. It is hoped that the thorough checking which the Year-Book makes possible will be effective in rectifying these so that the 1947-48 Year-Book may be dependably accurate.

MEMBERSHIP ON THE BOARD OF DIRECTORS

The terms of the representatives of the following Sections on the Board of Directors expired on 30 June, 1947:

Boston
California

Delaware
Hartford
Indiana
Iowa
Michigan
Metropolitan
Ohio
Philadelphia
Rochester
Southern Connecticut
Syracuse
Western Massachusetts

Present Directors will of course continue in office until their successors have been duly appointed and qualified.

Of the above Sections, the following have notified the Executive Secretary of the appointment of their Directors for the succeeding term as indicated:

Boston ..... Warren R. Purcell
California ..... Wyatt H. Lewis
Delaware ..... Wayne A. Kirklin
Metropolitan ..... Paul S. Olmstead
Ohio ..... Wade R. Weaver
Southern Connecticut ..... Elwood E. Folsom, Jr.
Western Massachusetts ..... Joseph J. Ferri

In order that the new Board may be completed as early as possible, and particularly that the new Executive Committee may be constituted and begin functioning promptly, all Sections listed above which have not appointed Directors for the forthcoming term are urged to do so immediately and to notify the Executive Secretary of their selections.

Present Directors are of course eligible for reappointment for succeeding terms where this is the wish of the Section concerned.

MEMBERSHIP ON THE EXECUTIVE COMMITTEE

The terms of the following Regional Directors expired on 30 June, 1947:

New England
Middle Atlantic
Central
Mid-West
Western

Mr. Wyatt H. Lewis has already been chosen Regional Director for the Western Region for the term 1947-49.

As soon as all of the Sections in any of the other Regions listed above, having Directors whose terms expired on 30 June, 1947, have notified the Executive Secretary of appointment and qualification of their new Directors, the Executive Secretary will notify all of the Directors in that Region of their duty to choose a Regional Director from among their own number.

In those cases where a Regional Director is reappointed as a Director to represent his Section for the forthcoming term, he is of course again eligible for selection as Regional Director where this is the wish of the Directors concerned.

In order that the new Executive Committee may be constituted and may begin functioning as promptly as possible, all Sections in the above Regions having Directors whose terms expired on 30 June, 1947 are urged to appoint their new Directors immediately and to notify the Executive Secretary of their selection.

MEMBERSHIP AND DUES FOR 1947-1948

By adoption of its new Constitution, the Society has increased its basic annual dues to $10.00, — $2.00 being remitted to the local Section, as in the past, for each member paying these dues. Such members are known as Senior Members, and the only eligibility requirements applicable to them in 1947-48 are that they be at least 24 years of age, and that they have at least two years' experience in quality control or inspection engineering work, or in the teaching of such subjects in a school of college grade. Since a college degree will ordinarily be accepted as the equivalent of one years' experience, the Senior Member grade obviously encompasses practically the entire present membership of the Society.

While the Society has felt that this increase in dues is well warranted by the cost and value of the services and advantages which it offers, and can be met without undue hardship by the vast majority of its members, it has recognized that such an increase would cause a real hardship to younger and less experienced men just starting in at beginners' salaries. Obviously it is from these men that the Society must expect to recruit its future Senior Members. The new Constitution accordingly provides a Member grade in the Society which offers corporate membership to young and inexperienced men at the old $5.00 annual dues. The only eligibility requirements applicable to Members of this grade are that they shall be at least 21 years of age and that they shall be interested in quality control. Only $1.00 of their $5.00 dues is remitted to the local Section.

The new Constitution also provides for a Fellow grade at $15.00 annual dues for members of substantial maturity and experience, but there has not yet been sufficient time since its adoption to permit working out the necessary details for accomplishing transfers of members to this grade.

Members of all three grades are equally entitled to all of the rights and privileges of corporate membership. Through its membership grades, the Society merely affords recognition to the differing degrees of experience and maturity of its members. In turn, the more mature members, through their higher dues, discharge their correspondingly greater responsibility to support the interests common to the entire membership.

The Constitution contains no requirement forcing any member to transfer to the Senior Member grade or to the Fellow grade, and no member who cannot afford it should transfer. The vast majority of the present members of the Society can certainly afford the Senior Member dues however, and they should wish to carry their fair proportion of the cost of maintaining and operating the Society.

The entire dues structure in the new Constitution contemplates a substantial proportion of the membership in the Senior Member grade. Failure of the membership to recognize and discharge its responsibility in this matter will merely necessitate steps to increase the dues for the Member grade. This would in turn drive from the Society many younger men unable

to meet the higher dues, — a result which would defeat one of the main objectives of the Society, and which could not fail, in the long run, to react to the disadvantage of the entire membership.

PAYMENT OF DUES FOR 1947-1948

In line with the provisions of the new Constitution, the Society will accept until further notice, from secretaries of Sections, certifications that American Society members or prospective members are Section members in good standing and meet the qualification requirements for the Senior Member grade as outlined in the immediately preceding article in this issue of the magazine. When accompanied by remittance of $8.00, such certification will automatically enroll the member or applicant as a Senior Member of the American Society.

Similarly, the Society will accept hereafter, from secretaries of Sections, certifications that applicants for membership in the American Society are Section members in good standing and meet the qualification requirements for the Member grade as outlined in the immediately preceding article in this issue of the magazine. When accompanied by remittance of $4.00, such certification will automatically enroll the applicant as a Member of the American Society.

Corresponding with the above arrangements, and pending completion of new Application Blanks, Transfer Blanks, etc., the Executive Secretary will accept "direct applications" on the old blanks for either the Senior Member grade or the Member grade when accompanied by remittance of $10.00 or $5.00, as the case may be, along with certification by the applicant that he meets the qualification requirements for the grade of membership applied for, as outlined in the immediately preceding article in this issue of the magazine.

No applications for the Fellow grade, and no dues payments therefore, will be accepted until the necessary Transfer Blanks are available and the Examining Committee has had opportunity to work out the details of its procedures in connection therewith.

MID-WEST SECTIONS INCREASE THEIR FOUNDING CONTRIBUTION

On 18 March, 1946, the Sections of the Society which participated in the First Mid-West Quality Control Conference forwarded to the American Society a Founding Contribution of $500.

As recorded in more detail under Annual Meeting — 1947, in this issue of the magazine, the Sections in the Mid-West Region forwarded to the Society on 25 June, 1947 an additional Founding Contribution of $1000.

President Edwards has written to Mr. Edward D. Thompson, General Chairman of the Second Mid-West Quality Control Conference, gratefuly acknowledging this added evidence of the loyal support of the Mid-West Sections, congratulating them on the success of their Second Conference, and thanking them for their hospitality in sharing it with the first Convention of the American Society.

FOUNDING AND SUSTAINING CONTRIBUTIONS TO THE SOCIETY

The 1946-47 Year-Book lists seven Founding Contributors to the Society. It included two such contributions from constitutent Sections of the Society and five from Companies interested in supporting our efforts along quality control lines.

With the completion of our first fiscal year on 30 June, 1947, further additions to our list of Founding Contributors are of course impossible. Our Constitution provides however for our continuing acceptance of voluntary contributions for the general support of the Society or for specific purposes approved by our Board of Directors. Such donors will be listed each year in our Year-Book as Sustaining Contributors.

It is hoped that many Companies (and others) may feel our efforts in support of quality control are of a character warranting their support in the form of a Sustaining Contribution, and that some may feel justified in placing their contributions on a more or less regular annual basis.

The Boston Section and the Sections in the Mid-West Region have set a laudable example in enrolling themselves as Founding Contributors. Perhaps it is not too much to hope that this will lead them and other Sections to become Sustaining Contributors.

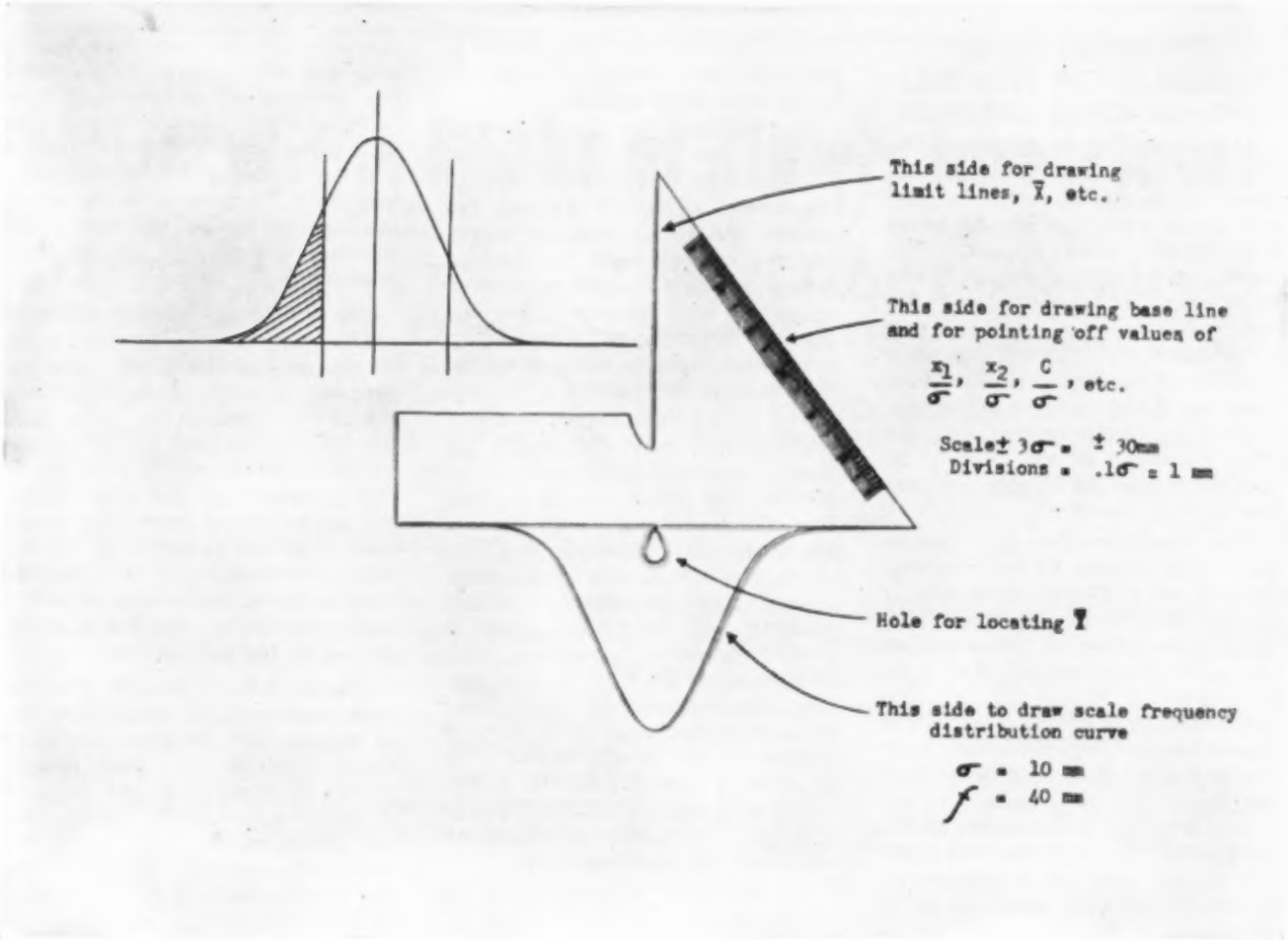
The American Society is operating on a basis which definitely limits its expenditures to the funds available to it. Lack of funds has made it impossible, during the past year, to undertake a substantial number of activities which would have been productive and of real value. The service which the American Society can give to its members and to quality control during the coming year, will be measured again by the funds which are available. Generous Sustaining Contributions will be a much-needed help and support to the Society in its attempt to do an adequate job.

A.S.Q.C. CONVENTION 1948

At the meeting of the Executive Committee in New York on 27 June, preliminary consideration was given to the matter of a 1948 Convention of the Society.

It was the general feeling of the Executive Committee that those who attended the 1947 Convention derived so much of value from it that they would look upon the arrangement of such meetings, something like once a year, as one of the more important services which the Society could render to its members. The Committee appeared in general to favor holding successive Conventions in different Regions, though there was no unanimity on this point. It appeared generally agreed that June is somewhat late in the season for such meetings, and that the aim should be rather for February or early March.

The Executive Committee agreed to proceed with exploratory discussions and tentative preliminary plans for a Convention sometime prior to the first of April in 1948. First decisions to be made will involve determination of the Convention city, the character and extent of the program, availability of necessary accommodations, the Convention date, etc. Members having suggestions bearing on any of these matters should get them into the hands of their Regional Director as early as possible. It is to be understood of course, that attempts to develop plans along these lines may very possibly make it clear that a 1948 Convention will be inadvisable.


This side for drawing limit lines, $\bar{X}$, etc.
This side for drawing base line and for pointing off values of
$\frac{x_1}{\sigma}$, $\frac{x_2}{\sigma}$, $\frac{C}{\sigma}$, etc.
Scale ± 3σ = ± 30mm
Divisions = .1σ = 1 mm
Hole for locating
This side to draw scale frequency distribution curve
σ = 10 mm
f = 40 mm

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In making an analysis of the frequency distribution of a product characteristic (length, diameter, strength, test, etc.) it is often desired to picture the product distribution in scale relation to the specified limits. The following procedure is ordinarily required:

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5. Draw lines representing specified limits.

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COORDINATION OF SCHEDULES FOR REGIONAL AND NATIONAL MEETINGS

At its meeting on 27 June, the Executive Committee discussed at some length the number and frequency of meetings having more than strictly local appeal. The matter of conflicting dates, both among such meetings and with the National Convention, also came in for consideration. For the general steering of questions of this character, the Executive Committee appointed a Sub-Committee with the Vice President of the Society as Chairman and all of the Regional Directors as members.

This Sub-Committee is to inform itself with regard to all meetings planned on any basis other than of strictly local appeal. When any proposed meeting of this character comes to its attention, the Sub-Committee is to attempt to enlist the cooperative efforts of all of the Sections in the Region, in contributing to the meeting and in furthering its success as a bona fide Regional Meeting of the American Society. To this end, the Sub-Committee will attempt to coordinate schedules for such meetings so as to avoid conflicting dates, either among the Regional Meetings or with the National Convention. The frequency and total annual number of such Regional Meetings will also be important factors to be considered by the Committee.

Section Secretaries and Meetings Chairmen are requested to cooperate with the above Sub-Committee by informing Mr. Halton promptly of plans under way or in contemplation for meetings in which the Sub-Committee would have an interest.

BOOK REVIEW

CONTROL CHARTS IN FACTORY MANAGEMENT. William B. Rice. John Wiley and Sons, Inc., New York; Chapman and Hall, Ltd., London, 1947. Review by Warren R. Purcell, Sylvania Electric Products, Inc.

CONTROL CHARTS IN FACTORY MANAGEMENT fills an important need for the busy executive who wants a picture of control chart techniques but whose schedule does not permit extensive study. Its well-proportioned perspective is valuable also to those who specialize in controlling quality.

The introduction is addressed primarily to general executives. Mr. Rice then discusses the role of inspection, statistical control, the control chart for measurements, and the control chart for fraction defective. One chapter is devoted entirely to case histories. The last chapter is addressed primarily to those who organize and administer statistical quality control programs.

The introduction points out that management must distinguish between variations which call for attention and those which do not. Five axioms of quality control are set forth: (1) Wherever like products are turned out in quantity, control chart techniques are applicable. (2) Variability exists in every repetitive operation. (3) Quality must be built into a product, it cannot be introduced through inspection. (4) A state of control is not usually found. (5) A state of control must be established at a satisfactory level before maximum efficiency in the operation can be obtained.

By logic and by case history the author establishes that routine detail inspection does not assure perfect quality. Sample inspection followed by careful detail inspection of rejected lots is more likely to be successful in attaining this objective. Inspection fulfills its highest function when, as process inspection, it helps to make things right in the first place, and final inspection is used merely as a double check.

Statistical analysis assists in the evaluation of the capability of a process. Attaining control without meeting tolerances and meeting tolerances without attaining control both fall short of the objective of valid predictability of satisfactory operations. Modern control sampling is to classical sampling what on operating statement is to a balance sheet; it is a dynamic flow chart rather than a static cross section.

Mr. Rice recommends six steps to be taken before a control chart for measurements is started: (1) Decide what to control. (2) Study the process. (3) Study the inspection methods. (4) Prepare forms. (5) Choose rational subgroups. (6) Set up procedures. He illustrates the operation of the technique by an excellent case history. He discusses the subjects of sample size and runs, and sets useful criteria for testing the validity of control charts and for deciding when to recalculate limits. He gives a timely warning against entire reliance upon statistics without the use of common sense.

The chapter on fraction defective charts will probably be the controversial part of the book. The impression prevails throughout that the author regards the upper control limit as the limit of the fraction defective of the entire product. To this reviewer, on the other hand, the upper control limit is the maximum fraction defective to be expected in **samples**, if the **product** fraction defective remains **substantially constant** at the value represented by the central line.

The case histories are practical and realistic. Many are illustrations of the use of fraction defective charts. While Mr. Rice demonstrates in these cases the value of a logical approach to quality control problems, he does not, in this reviewer's opinion, establish that the control limits have any value in the solutions to the problems presented, with one notable exception. The exception is the valuable observation that consistently poor operators need constant training and supervision, while good but erratic operators need occasional attention. The cases illustrating the use of charts for measurement are excellent illustrations of true control chart technique. Three of the cases are interesting illustrations of the extension of control charts to the fields of production volume, production flow, and cost study.

Chapter 6 is one of the best contributions to the literature that this reviewer has seen. It is "must" reading for any one who has the responsibility of organizing a statistical quality control program. With excellent appreciation of the importance of jurisdictional jealousies and the influence of personalities, Mr. Rice points out the personal qualifications, training, and experience needed by the outside consultant, new employee, or old employee who embarks upon the project. The pitfalls and methods of avoiding them are admirably described.

McGraw-Hill Books of Timely Importance

STATISTICAL QUALITY CONTROL

By Eugene L. Grant, Stanford University. *McGraw-Hill Industrial Organization and Management Series.* 563 pages, $5.00.

This distinctive book deals with the laws of probability that may be used to improve acceptance procedures and thus secure the best possible quality assurance from a given inspection cost. Explains the Shewhart control chart, its use in manufacturing to reduce costs of spoilage and rework, and to obtain a better coordination between design, production, and inspection. The careful explanation of basic principles is accompanied by many practical examples demonstrating the broad usefulness of quality control techniques in dealing with quality problems in mass production.

SAMPLING INSPECTION

By the Statistical Research Group, Columbia University. OSRD-NDRC. 393 pages, $5.25.

Gives principles, procedures, and tables for single, double, and sequential sampling in acceptance inspection and quality control based on percent defective. The elementary concepts of acceptance sampling are carefully treated, a standard sampling-inspection plan is supplied, and detailed instructions are given so that the principles developed and plans supplied can be used for practical inspection of industrial products. Much of the material has not previously been published.

SELECTED TECHNIQUES of STATISTICAL ANALYSIS

For Scientific and Industrial Research and Production and Management Engineering.

By the Statistical Research Group, Columbia University. OSRD-NDRC. 442 pages, $6.00.

Discusses a series of problems frequently encountered in planning, analyzing, or interpreting quantitative data, and explains various techniques appropriate to these problems. Expounds the statistical approach to a problem, the theory that can be brought to bear upon it, and points out the features of the problem that determine the relevance of the theory. Gives detailed computational procedures, and illustrates the interpretation of the results.

CONTROL CHARTS

By Edward S. Smith, University of Cincinnati. *McGraw-Hill Industrial Organization and Management Series.* 181 pages, $3.00.

A text on the purposes, construction, and interpretation of the charts of statistical quality control, intended primarily for men in industry. The treatment is simple, and practical applications are emphasized rather than the development of mathematical formulas. The charts are developed gradually, with careful explanations and clear diagrams. An unusual feature is the simplified, nonmathematical, yet detailed treatment of frequency curves and their value in interpreting statistical data.

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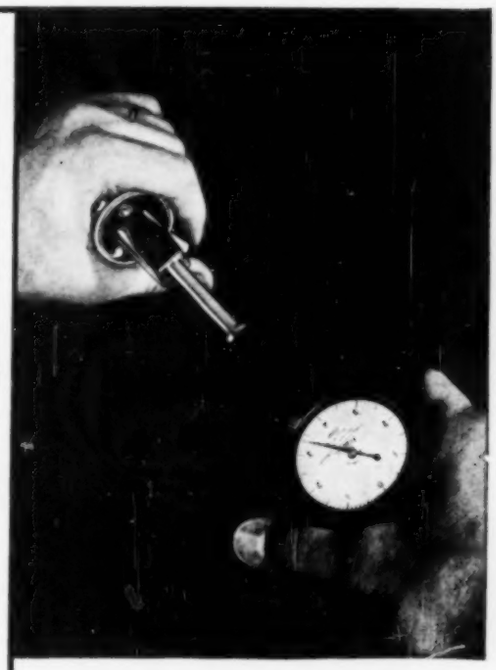

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